AMERICAN ENGINEER

"THE RAILWAY MECHANICAL MONTHLY"

(Including the Railway Age Gazette "Shop Edition.")

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH, BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY,
83 FULTON STREET, NEW YORK, N. Y.

CHICAGO: Transportation Bldg. CLEVELAND: Citizen's Bldg.
LONDON: Queen Anne's Chambers, Westminster.

EDWARD A. SIMMONS, *President.* HENRY LEE, *Secretary.*
L. B. SHERMAN, *Vice-President.* A. E. HOOVEN, *Business Manager.*
The address of the company is the address of the officers.

ROY V. WRIGHT, *Editor.* R. E. THAYER, *Associate Editor.*
E. A. AVERILL, *Managing Editor.* A. C. LOUDON, *Associate Editor.*
GEORGE L. FOWLER, *Associate Editor.*

Subscriptions, including the eight daily editions of the *Railway Age Gazette* published in June in connection with the annual conventions of the Master Car Builders' and American Railway Master Mechanics' associations, payable in advance and postage free:

United States, Canada and Mexico.....$2.00 a year
Foreign Countries (excepting daily editions)..... 3.00 a year
Single Copy ..... 20 cents

Entered at the Post Office at New York, N. Y., as mail matter of the second class.

WE GUARANTEE, that of this issue 4,125 copies were printed; that of those 4,125 copies, 3,760 were mailed to regular paid subscribers and 125 were provided for counter and news companies' sales; that the total copies printed this year to date were 10,276 copies—an average of 5,138 copies a month.

VOLUME 87. FEBRUARY 1913. NUMBER 2.

CONTENTS

EDITORIALS:
Car Department Competition 57
Exhibits Open During the Evening 57
Moving Pictures and Fuel Economy 57
The Finishing Shop 58
New York Central Steel Coaches 58
Air Brake Hose 58
Jacobs-Shupert Boiler Tests 59
New Books 60

COMMUNICATIONS:
The Advertising Pages 62
Defective Box Cars 62
Equivalent Heating Surface 62
Tire Turning Record 62

GENERAL:
Tests of Jacobs-Shupert Boiler 63
Moving Pictures in Railway Educational Work 67
Curves of Locomotive Operation 68
Tests of Spring Steel 70
The Division Master Mechanic 70
Superheater and Feed Water Heater 71
Tabular Comparison of Recent Locomotives 72
New Design of Trailer Truck 74
Taking Up Lateral Play 74

SHOP PRACTICE:
Machine Shop Kinks 75
Driving Box Kinks 75
Iron Rack for Short Lengths 76
Replacing a Driver Spring on a Mallet 76
The Bulldozer in Railway Shops 77
Apprentice Schools on the Erie 80
Shop Kinks 81
Milling Attachment for Lathes 84
Shop Hospital Room 84
Miscellaneous Shop Kinks 85

CAR DEPARTMENT:
Caboose Laws 87
A Collapsible End Construction for Passenger Equipment 87
New York Central Lines Steel Coaches 89
The Electro-Pneumatic Brake 95
Mirror for Inspecting Arch Bars 96
Truck Equalizer Design 96
Specifications for Postal Car Lighting 97

NEW DEVICES:
Horizontal Drilling and Boring Machine 99
Shaper for Driving Boxes 100
A New Design of Car Coupler 101
Automatic Cylinder Cock 101
Pries Outside Metal Car Roof 101
Improved Rod Brass 102
Pneumatic Drill Press Clamps 103
Device for Securing Hand Holds 103
Compound Locomotive Air Pump 104
Car and Truck Locking Device 104

NEWS DEPARTMENT:
Notes 105
Meetings and Conventions 106
Personals 107
New Shops 108
Supply Trade Notes 109
Catalogs 110

Car Department Competition

Remember that the car department competition, which was announced in our issue of December, 1912, and January, 1913, will close on February 15, and that all manuscripts must be received by that time. A prize of $50 will be given for the best article on a car department subject of special interest to our readers. Papers, not awarded the prize, but accepted for publication, will be paid for at our regular space rates. Mail your contribution at once.

Exhibits Open During the Evening

Among the reasons in favor of keeping the exhibits at the Atlantic City conventions open during the evening are: the opportunity for an exhibitor to obtain a greater benefit from his exhibit and a better return on the money invested in it; a chance for the members of the association to more fully inspect the exhibits, to do so with less haste and with an opportunity of talking with the manufacturer or his representative without constant interruption; a source of attraction which will bring everyone connected with the conventions to the pier during the evening, a result which is greatly to be desired from every standpoint; an increase in the number of railway men in other departments who will visit the exhibits for but one or two days, and a bigger, better and more worth while exhibit in every way. What are the objections to a trial of the idea?

Moving Pictures and Fuel Economy

Prominent among the problems which confront motive power officers is that of fuel economy, and various plans are in force or have been tried out on different roads in the effort to reduce fuel consumption and eliminate waste. In some cases a special branch of the motive power department has been inaugurated to deal with economy in fuel and supplies in general, the most recent road to adopt this system being the Rock Island. It can scarcely be questioned that the most satisfactory method of instructing firemen in the proper methods of performing their work is by individual instruction, but as a rule conditions will not permit this to be done. The question of proper instruction along these lines seems to have been simplified to a very material extent on the Union Pacific by the use of moving pictures, as described elsewhere in this issue, and the results obtained should be encouraging, not only to those directly connected with the work, but also to motive power officers in general.

Choosing at random from the numerous important points which might be considered, the condition of the fire when a locomotive is brought into a terminal is worthy of attention. It is astonishing how many firemen, considered to be experienced, will bring in fires banked high with fresh coal, by far the greater part of which must go into the cinder pit as waste. This leads directly to the waste of steam by popping, a point brought out by the moving pictures in a most impressive way. It is difficult at any time to impress on hostlers and others having to do with the handling of locomotives at terminals, that there is no need of keeping the steam pressure of locomotives, while they are in or about the engine house, constantly at the blowing off point. When a locomotive comes in with a bright, hot fire and requires only enough steam pressure to work it into the engine house, either the surplus steam must escape through the pops, or the boiler must be cooled. In an effort to cool the boiler, the blower is turned on hard with the fire door open and probably an injector is started. In nine such cases out of ten, whether or not the tubes were dry on arrival, they will be leaking badly when the locomotive reaches the engine house. There are cases of leaky boiler tubes without number that can be directly traced to the ash pit handling, and the only way to improve such conditions is to instruct the men in the proper methods. To obtain satisfactory results the in-

struction should not stop after one lesson, but be continued periodically, and moving pictures seem to offer an easy and effective means of doing this.

The Finishing Shop

When a locomotive leaves the shop after heavy repairs it is not, in most cases, immediately ready for service, and often the work that is to be done on defects developed during the breaking in runs will hold it for two or three days longer before it can be safely delivered for the use of the transportation department. If the shop is working efficiently and on a schedule, the return of these locomotives that are being broken in, for some minor work, interferes with the routine and may result in an aggravating delay in finishing other locomotives. Again, there is much work required just before the engine goes out, such as the re-application of piping, putting in cab fittings, painting, attaching the tender, filling the boiler and firing up, which does not require the facilities of the main shop and during busy times it should not be occupying room in the erecting shop. When the roundhouse is adjacent to the shop it has been the practice to make these repairs there, but a large shop requires the constant use of several pits for this purpose with the necessity of the men going back and forth, to the main shop, as the roundhouse forces could not be expected to do this finishing work, and the result, while an improvement, is not altogether satisfactory, especially where a roundhouse foreman needs all of the pits that he has. The best solution is the building of a separate small shop adjacent to the erecting shop where the pits are provided and used entirely for this finishing work, and several of the larger shops are finding this arrangement most satisfactory.

The most recent instance of this kind, is the erection of such a building at the Scranton shops of the Delaware, Lackawanna & Western. In this case, it is located directly across the transfer table from the main erecting shop and has four pits. It is of a structure in keeping with the remainder of the plant, has 50 ft. concrete pits and a floor of creosoted wooden blocks. Smoke jacks are installed at both ends of each pit and all finishing work and repairs reported by the engineer after the breaking in trip, as well as the attaching of the tenders, etc., is performed here. It is heated with steam, piped throughout for hot water and compressed air, and lighted with electricity.

New York Central Steel Coaches

A design of steel passenger cars prepared by the mechanical department of the New York Central Lines working in conjunction with the builders, is especially noticeable in two particulars. One is the exceptional thoroughness of the insulation and the other, the very strong end construction. Great difficulty has been experienced in keeping steel passenger cars at a comfortable temperature in severe winter weather and the drain on the locomotive for heating the cars has been greatly increased at just the time that more steam is needed for propulsion. While it is possible to properly heat these cars by putting in a large radiation surface and supplying it with sufficient steam, the better way is to prevent, as far as possible, the transmission of the cold air to the interior of the car or the loss of heat to the outside. Where there is a continuous metal connection between the inside and the outside of the car body, the transfer of the heat and its dissipation on the outside sheathing is very rapid, but where the continuity of such a metal path is broken with even a thin sheet of non-conductor the loss will be greatly decreased. In the New York Central cars an effort has been made to avoid all continuous metallic connection between the inside and the outside, and practically without exception, the effort has been successful. Furthermore, a sheet of insulation is secured to the back of the outside sheathing and another heavier one on the back of the inside sheathing or finish. As a further preventive the circulation of air between the parts of the framing or under the floor has been prevented.

Experience with steel cars in wrecks has shown them to be practically invulnerable except when an adjoining car or a locomotive pierces the body end framing. With an end construction sufficiently strong and properly designed, the chance for loss of life in a steel car, under any condition, is very slight. On the cars under discussion the diaphragm posts of the vestibule are very heavy and securely supported, but are considered only as the advance guard, the greater resistance being encountered at the end of the body. This consists of two 6 in., 15.6 lb. Z bars at the corners, set in a pocket in the underframe casting at the bottom and securely supported at the top. These are reinforced by large cast steel knees extending up as high as the belt rail. The door posts are 6 in., 12¼ lb. I beams, also set in pockets in the underframes and most securely fastened at the top to an end plate arranged to give an exceptional resistance in the horizontal plane. These main members taken in connection with the intermediate 4 in. Z bar posts and the steel sheathing present a structure which appears to be able to arrest the movement of any body, especially after it has crushed the vestibule framing.

Air Brake Hose

In considering the subject of improved air brake hose the question arises as to how great an increase in cost is justified by the conditions of service. Without doubt much of the present trouble with the hose is caused by difficulties not directly associated with the material, and if these are the basis for any considerable proportion of the removals, the amount of increased cost that will be justified for better material is reduced in the same proportion. Unless there is a time limit provision compelling the removal of air brake hose after a certain length of service, the use of a better hose, in the final analysis, is not going to reduce troubles caused by poor hose, and the argument in favor of its use is entirely economic. If, for instance, a car has at one end a high-priced hose which has been in service for two years and at the other end a low-priced hose which has been in service for eight months, the chances of failure at either end of the car will be equal and the better quality of material has resulted only in a longer life. Considering the matter entirely from the standpoint of freight cars, no road is justified in using a better quality of air brake hose than is required by the rules of interchange, and it is not to be expected that any road will do so. Therefore the revision of the M. C. B. specifications should be designed to insure the maximum quality which it is believed the service justifies. It can be concluded that no road will provide a better hose than the specifications require, and some may apply a poorer one. While the conditions of service may not justify the use of a very high-priced hose on freight cars, there is no one who has had the temerity to argue that the present hose is good enough.

The effect of most of the so called "users defects" will in some particulars increase in the same ratio as the length of life of the hose and an increase in the quality will increase the percentage of hose removed on this account, and it would thus seem advisable to require the use of a material which will have a normal life equal to the probable length of service before having to be removed for these causes. The first problem to be solved is the determination of the exact conditions in this regard. Next, it will be necessary to know what effect the improvement in the quality of the material will have in reducing these defects. With these questions settled the desired length of life would be known approximately and a material could be specified which, while possibly not the best obtainable, would be good enough to give efficient service. If that is done, however, and the expectant life of the hose is fifteen or eighteen months, or possibly two years, the rules should provide for its removal at the expiration of that time, independent of all other causes. If such a time limit does not seem feasible, the hose should be of a quality to insure the maximum practical length of service and

thus make users defects responsible for nearly all the removals.

Probably the principal difficulty with the present hose is rapid deterioration after being put in service. This is very largely due to the use of shoddy and rubber substitutes. In either of the suggested plans, the use of such materials should be prevented, and it seems probable that a rigid tension test would accomplish this. It has also been suggested that a harder composition be required for both the inner tube and the outer cover, and that less attention be given to the stretching test. Furthermore, that the outer cover should be of a better weather resisting quality than the inner tube. Both of these requirements would tend to reduce the troubles from users defects.

After a satisfactory quality of material is obtained, however, but part of the problem has been solved and attention should be given to compelling the use of properly designed fittings, proper methods of applying them and greater care in the application of the hose to the car. While the present design of coupler, when the hose is properly put up, will separate with no material damage to the hose, it so frequently occurs that either the couplers are not in line, or they have been in service so long as to be out of shape, and the strain imposed on the hose when uncoupling automatically is very severe and causes serious damage. The nipples used and the methods employed in applying them in some shops would indicate that efforts were being made to destroy the hose as quickly as possible, and the fact that any hose, after such treatment, is capable of service at all, is surprising.

Jacobs-Shupert Boiler Tests

While it has always been realized that the heating surface in the firebox of a locomotive is much more valuable in producing evaporation than that in the flues, the exact relation could only be conjectured. Through the enterprise of the Jacobs-Shupert United States Firebox Company, however, data is now available which permits the designer of a locomotive boiler to approach the subject with much more confidence. It has been shown that with a typical locomotive boiler having tubes 18 ft. 2 in. in length in which about 7 per cent. of the total heating surface is in the firebox and when burning a long flame bituminous coal at normal rates of combustion the firebox evaporates 40 per cent. of the total steam from the boiler and the ratio of the heat absorbed per square foot by the firebox to that absorbed by a square foot in the tubes is as 6.15 to 1. This is without a brick arch in the firebox.

Before the results of these tests, valuable as they are, are used in practical design the conditions which held during the making of the tests and the possible effect on the results as well as the methods of competition should be thoroughly understood. Primarily, the tests were intended entirely as a comparison between two different types of fireboxes applied to otherwise exactly similar boilers and all conditions during the same tests on both boilers were alike. In neither case, however, were these conditions exactly normal. The tests proved conclusively that, as steam makers, the two boilers were practically equal. The low water tests which were made later, however, proved that the Jacobs-Shupert sectional firebox was very much the superior under the conditions of the trials.

In the first series of evaporation tests it was necessary, since the evaporation of the two parts of the boiler was to be determined by the amount of feed water injected into each, to separate the firebox from the barrel with a water tight partition which consisted of an extension on the back tube sheet. This prevented all circulation between the two parts and necessitated the injection of feed water into the firebox section as well as through a check valve in the usual position. The feed water in the firebox section was discharged through a perforated pipe extending for practically the full length of the box and located over the center of the crown sheet. Since the rate of heat transferred through a sheet depends on the difference in temperature in the two sides of the sheet, it is probable that the entrance of the cold water at practically the hottest part of the firebox resulted in a considerable increase in the rate of heat transfer at that point. On the other hand, it required the cold water to gradually find its way down along the outer sheet in the water legs and probably decreased the normal amount of circulation and increased the average temperature of the water in the water legs, thus decreasing the heat transfer through the side sheets. Again, the injection of the cold water directly to the firebox section, which under normal conditions is supplied with water that has already been heated in the barrel, required it to do more work in delivering the same amount of steam. With the front end temperatures and the efficiency of combustion the same, the distribution of heat between the firebox and the tubes will depend on how much the firebox can absorb, since the tubes will only be supplied with the remainder. If then, the conditions of the test were such as to permit the firebox to take up a larger portion of the heat than would be the case if it had received water from the barrel of the boiler, the tubes would be somewhat handicapped and the fact that the boiler in its normal condition and receiving feed water only through the usual check valve, gave practically the same efficiency that it did when it was tested with the partition between the firebox and the barrel, would not be conclusive proof that the distribution between the firebox and the tubes was exact. While the tests on circulation, which were all confined to the movement of the water in the water legs, proved that the currents were not as strong, nor as direct as had been supposed, and also indicated that the movement from the barrel to the firebox is very gradual, it must be remembered that when the circulation tests were made, the firebox was fitted with two large arch tubes which was not the case when the separate firebox tests were made. While we have no exact knowledge of the rapidity of the movement of the mixture through the arch tubes, there is no doubt but what it is very rapid and would decidedly affect the character of the circulation in the side water legs.

It is to be regretted that the facilities for the tests and the time allowed did not permit a more complete investigation to check the effect of these various features, but it would hardly be just to expect a manufacturing company to stand the expense of a series of tests which would probably extend over two years and develop facts, which, while of great value to the engineering world in general, would be of no particular importance in its own field and the Jacobs-Shupert United States Firebox Company is entitled, and should receive the hearty commendation of all engineers for the work it has done.

In connection with the results, as published in Dr. Goss' report, attention should be drawn to a few features which, if not understood, might lead to some error in the use of the data. The firebox heating surface of the Jacobs-Shupert firebox is the developed area of the sheet, which gives this box 21.4 sq. ft. greater heating surface than the radial stay firebox. This is an increase of over 14 per cent., and the unit figures of evaporation from the Jacobs-Shupert firebox are smaller by that amount than would be the case if the projected area had been used. The evaporation from the back tube sheet is credited to the firebox by being pro-rated on the basis of each square foot being equivalent to the average square foot of the rest of the firebox, and this amount is deducted from the evaporation of the barrel. This area amounted to 27.5 sq. ft. for the radial stay boiler and 28.9 sq. ft. for the Jacobs-Shupert. The heating surface of the tubes is figured on the inside surface, while the published heating surface of other boilers is given for the outside of the tubes. The difference in this case is to reduce the amount of tube heating surface by 10.8 per cent. The area of the front tube sheet which amounts to 18.6 sq. ft. in both boilers, is included in the heating surface. This area is not included in the published heating surface of locomotive boilers. The area of the arch tubes is not included in the heating surface in connection with the results of evaporation

after the arch was installed. The report does not state whether the arch tubes were in place during the tests without a brick arch, and without this information it is impossible to determine whether the increased evaporation as given by the arch is due entirely to the improved combustion or whether part of it should be credited to the heating surface of the arch tubes.

NEW BOOKS

Shop Notes. Edited by H. H. Winsor. 208 pages. 6½ in. x 9½ in. Illustrated. Bound in paper. Published by *Popular Mechanics*, Chicago. Price, 50 cents.

This is the ninth annual year book of the *Popular Mechanics* Shop Notes and is a collection of the articles published during the past under that head in the monthly edition of the magazine. It includes 595 easy ways of doing things in the several trades. The items are all original and are simple in construction, making it possible for a handy amateur to duplicate them. A complete index is given in the back of the book.

Density and Thermal Expansion of Linseed Oil and Turpentine. By H. W. Bearce, Assistant Physicist, Bureau of Standards. Technological Paper No. 9. Published by the Bureau of Standards, Washington, D. C.

This pamphlet has been prepared in response to a demand for a more complete knowledge concerning the physical properties of linseed oil and turpentine. Samples were taken from various manufacturers in different localities throughout the country. The apparatus and method of procedure used is thoroughly described, together with the results obtained and comparisons with previous tests. A good deal of the information is given in the form of tables of density, weight and volume as determined from the tests.

Coal. B. E. E. Somermeier, Professor of Metallurgy, Ohio State University. Bound in cloth. 167 pages. 6½ in. x 9½ in. Published by the McGraw-Hill Book Company, 239 West Thirty-ninth street, New York. Price, $2.00.

The information is largely based on private notes, scattered general information, technical bulletins, and original papers in technical journals. The author has endeavored to keep in mind throughout the work the mechanical and power plant engineer, the chemical engineer and chemist, and the non-technical business man who has to do with the buying and selling of coal. The work is divided into 10 chapters, the first dealing with the composition and heating value; the second with the chemical analysis; the third, fourth, fifth and sixth with the testing of fuel; the seventh and eighth with the improvement by washing and the general purchase of coal under specifications; the ninth thoroughly discusses the method and theory together with the results obtained through gas analysis by the Orsat apparatus; the tenth chapter is given over to analytical tables, giving the composition of various kinds of coal found throughout the United States. The book contains a few diagrams, clearly illustrating the various methods used in the testing of coals.

The Elements of Heating and Ventilation. By Arthur M. Greene, Jr. Cloth, 5½ in. x 9 in., 315 pages, 223 illustrations. John Wiley & Sons, New York. Price, $2.50.

The aim of this book has been to bring together in logical order and in a small volume the necessary data from which to design the heating and ventilating systems of buildings. There are twelve chapters dealing with methods of heating and of calculating the heat required; amount and condition of air for ventilation; loss and gain of heat; radiators, valves and heat transmission, etc. Direct steam, indirect and hot water heating are all dealt with, as well as furnaces and boilers, district heating, temperature control and drying by air. Numerous tables and charts are used throughout the book.

International Railroad Master Blacksmiths' Association. Proceedings of the 1912 Convention. Bound in cloth. 334 pages, 5½ in. x 8¼ in. Published by the International Railroad Master Blacksmiths' Association, A. L. Woodworth, Secretary, Lima, Ohio.

The twentieth annual convention of this association was held in Chicago, Ill., August 20-23, 1912. Among the subjects considered were Drop Forging, Frog and Track Work, Forging Machines and Dies, Springs and Spring Making, Frame Making and Repairing, Heat Treatment of Metals and Piece Work.

A Treatise on Cement Specifications. By Jerome Cochran. Cloth bound, 6 in. x 9 in., 101 pages, 7 illustrations. D. Van Nostrand Co., New York. Price $1.00.

While the author recognizes in his preface the impossibility of drawing specifications for cement which will be applicable to all classes of work and under all conditions, he has tried to make the presentation of the subject more complete than has ever before been attempted. The specifications proper cover 76 pages and include clauses on general conditions governing the use of cement, furnishing it to the contractor, purchasing it from manufacturers, delivering and storing it, inspecting and testing, testing requirements, methods of testing, and significance of tests. In addition to the specifications there are chapters on methods of mechanical analyses of Portland cement, bibliography of specifications for cement and bibliography of foreign cement specifications. The work is intended as a guide to students and young engineers in the preparation of specifications, and the aim has been to make this set consistent and in conformity with modern practice.

An Extension of the Dewey Decimal System of Classification Applied to the Engineering Industries. By L. P. Breckenridge and G. A. Goodenough. Bulletin No. 9 (revised edition). University of Illinois Engineering Experiment Station. Size 6 in. x 9 in., 117 pages. Price, 50 cents.

The filing and classification of engineering data has become a matter of much importance, and this bulletin was prepared for use as a guide in carrying out such work. Bulletin No. 9 was originally issued in 1906, and the demand was so great that a second edition was printed and distributed, 20,000 copies in all having been sent out. The demand for the bulletin having continued, the revised bulletin has been prepared with a number of changes and extensions presenting subdivisions of subjects in such detail as to constitute a complete classification for most industries, even though they are highly specialized. This revision has been made in accordance with the 1911 edition of "Decimal Classification," by Melvil Dewey. The experiment station is unable to make this revised bulletin subject to gratuitous distribution and a charge of 50 cents is made for copies postpaid.

Locomotive Dictionary. 1912 (Third) Edition. Compiled and edited for the American Railway Master Mechanics' Association by Roy V. Wright, managing editor of the *Railway Age Gazette* and editor of the *American Engineer*, assisted by Porter L. Swift. Illustrated. 901 pages. 9 in. x 12 in. Published by the Simmons-Boardman Publishing Company, New York, and distributed by the McGraw-Hill Book Company, 239 West 39th street, New York. Price, leather bound, $6; cloth bound, $4.

The progress made in the design of locomotives, both steam and electric, during the past three years is well illustrated by the contents of this edition of the Locomotive Dictionary when compared with the 1909 edition. It has been necessary to go beyond a mere revision of the previous edition, and so far as the illustrated section is concerned, it is a practically new book. The definition section also has been thoroughly revised and considerably expanded. While the Mallet, Mikado and Pacific type locomotives have been given special attention, the lighter types are by no means overlooked. This is especially true in connection with the switching and Atlantic type locomotives. In connection with each locomotive elevation a complete list of dimensions, weights and ratios is given, an improvement which, no doubt, will be

much appreciated. It is evident that considerable study has been given to the selection of the typical parts and details that are presented and only approved designs that have been successful in service are illustrated. Cross references between the general and detail drawings are included wherever possible. Among the new sections that have been added are one on mechanical stokers and one on locomotive tool equipment; the sections on oil burning locomotives, electric locomotives, air brakes, and frames and frame bracing have been materially enlarged. The illustrations showing the Master Mechanics' standards have been entirely redrawn, making them more legible and greatly improving their appearance. The section on machine tools occupies 60 pages and gives photographic reproductions of practically all kinds of metal working machinery used in the repair of locomotives. The study of machine tool operations by L. R. Pomeroy, which first appeared in the April, 1909, edition of the *American Engineer & Railroad Journal*, and was included in the 1909 edition of the Locomotive Dictionary, is again presented.

Car Builders' Dictionary. 1912 (Seventh) Edition. Compiled and edited for the Master Car Builders' Association by Roy V. Wright, managing editor of the *Railway Age Gazette* and editor of the *American Engineer*, assisted by Andrew C. Loudon. Illustrated. 953 pages, 9 in. x 12 in. Published by the Simmons-Boardman Publishing Company, New York, and distributed by the McGraw-Hill Book Company, 239 West 39th street, New York. Price, leather bound, $6; cloth bound, $4.

The Car Builders' Dictionary is too well known to require any description, and this, the seventh edition, does not differ materially in plan and scope from its predecessors. However, it cannot be properly designated as a revision of the last edition, since it is to all intents and purposes an entirely new book. The progress in car design and construction has been so great during the past three years that a large part of the illustrated section of the 1909 edition was found to be obsolete. The designs illustrated in the present edition have been most carefully selected and represent approved modern practice in every particular. The smaller and lighter equipment has by no means been overlooked, but recent improved designs have been chosen as examples. It is evident that the utmost care has been used to make the book complete and to cover the full range of rolling stock. This has resulted in a material increase in the size of the volume, in spite of the fact that the machine tool section given in the previous edition has been eliminated. The drawings are fully dimensioned, and all of the more important details are shown separately. A cross reference giving the location of the drawings of associated parts accompany many of the captions and are one of the new features which will be fully appreciated. One of the most valuable parts of the book is that containing the standards of the Master Car Builders' Association, which are given complete, and in each case have been redrawn on a larger scale, making them much more legible than those furnished by the association. In the definition section, all of the new terms that have come in general use during the past few years have been included, and their meaning made clear. Definitions of other terms have been completely revised, and in many cases entirely reworded. Among the new features are the complete details and specifications for postal cars as required by the United States government. The section on electric motor cars has been greatly extended, and an entirely new section on wrecking equipment and tools has been added. Typographically the book presents a much more pleasing appearance than former editions, and the reproduction of the photographs is particularly well executed, permitting a study of many of the details which are commonly lost in the final impress of half tones.

Die Beleuchtung von Eisenbahn-Personenwagen (The Lighting of Passenger Cars). By Dr. Max Büttner, Berlin. 235 pages, 6 in. x 9 in., 108 illustrations. Cloth. Julius Springer. Price 7 marks ($1.75).

The title of this book would be more descriptively accurate if it were to be called the Lighting of Passenger Cars by Electricity, for though lighting by candles, oil and gas is discussed, it occupies but 25 pages of the book. The balance is entirely devoted to a description and discussion of the different methods of electric lighting in use. In the brief reference to the earlier forms of lighting, the Pintsch and Frost systems are described, as well as a few lamps for burning oil and for holding candles. The methods of electric lighting are divided into three classes: Those in which the current is supplied by an accumulator; by a dynamo in the baggage car or other compartment of the train and driven by its own steam engine; and a dynamo driven from the axle of the moving car. The list of the several types of each of the three classes is quite complete, so far as European practice is concerned, but does not quite cover everything that has been done in the United States. This statement applies more particularly to the work of the steam driven dynamo rather than to the axle system; for, among the descriptions of the latter class we find many that have been developed in the United States, so that as a book of reference for the engineer who is engaged, or is interested in this class of work, the book will fill an important role.

In the fourth chapter of the second part, the author gives descriptions of many attachments that are used, such as couplers and the like, and summarizes the situation and requirements for car lighting. According to Dr. Büttner, the same principles should be applied and the same requirements exist as for house or room lighting. The lighting should be of sufficient brilliancy so that passengers can see to read without straining the eyes. The light should be soft and uniform without flicker or variation, and the sources of the light must be so disposed that the eye will not be blinded or dazzled thereby, and the system should be so designed that the maximum amount of illumination will be obtained with a minimum of complication in the mechanism and consumption of power. The arrangement of the lamps should be so planned that, as far as possible, there should be the same amount of illumination at each point throughout the car. To accomplish this, it is not advisable to use a single lamp of high power at any one place, but rather a number of lamps of lower intensity scattered throughout the interior.

As a general thing, deck or ceiling lamps are preferred, though very many side lamps are in use. Referring to the construction of German cars, he states that where deck or ceiling lamps are used they must not be placed too high, and yet they should be high enough so that the shadows cast by the parcel racks will not interfere with the illumination. A height of from 6 ft. to 6½ ft. is recommended, which would hardly be sufficient for the American type of car. While the use of a glass shade to protect the incandescent bulbs from breakage is recommended, the author does not approve of a shade that will absorb any of the light, but urges the use of reflectors above the lamps in order to throw the rays of light down, and commends the practice of using special reading lamps back of the seats.

One paragraph in this discussion is of special interest, wherein there is given a summary of the amount of light furnished to different classes of German cars. The author says that the brilliancy of the illumination supplied varies widely on different systems of railways. The most brilliantly lighted cars in Europe are those of the Prussian State Railways that are fitted with reading lamps. In the first class compartments there are two lamps of 20 candle power each and four reading lamps of 6 candle power each. In the second class compartments, instead of the two of 20 candle power, there are two of 16 candle power. It is calculated that, with this equipment, the illumination is 16.8 candle meters on the floor of the first class car, and 14.8 on that of the second class, with the reading lamps in use. In the new cars the reading lamps have been abolished and the first and second class compartments are lighted with two lamps of 20 candle power each, while the third class are lighted with two of 16 candle power. These lamps are set about 6 ft. 6 in. above the floor and the illumination on the latter is from 10 to 10.5 candle meters. The illumination of the cars on other European roads is, for the most part, less than that just given.

COMMUNICATIONS

THE ADVERTISING PAGES

Minneapolis, Minn., January 15, 1913.

To the Editor of the American Engineer:

I wish to congratulate you on the appearance of the advertising pages in the recent issues. Several of your advertisers are taking advantage of their opportunities and furnishing us with real information, often of decided value and always interesting. I wish they would all follow the example of the leaders in this regard and break away from the hackneyed, stereotyped claims of superiority. If their machines are so much superior there must be good reasons for it. Why don't they give us practical examples of results and sound argument and allow us to judge the value of their product on this basis? We have to do it in the end, anyway. Reader.

DEFECTIVE BOX CARS

Albany, N. Y., January 15, 1913.

To the Editor of the American Engineer:

The article in your January issue, by R. W. Schulze, on Grain Car Inspection, deals with a number of important points connected with proper repairs to grain carrying cars. In a great many cases, however, much of the trouble and expense incidental to preparing cars for the transportation of grain and similar commodities would be unnecessary if the cars were better put together when built. The poor workmanship on many box cars makes them unfit for carrying any perishable product, even when they are new, and after they have been used a few months in general service their condition is almost hopeless so far as grain carrying is concerned. This helps greatly to increase the damage and short weight claims and can be bettered only by getting after the design and construction of new cars. Inspector.

EQUIVALENT HEATING SURFACE

Philadelphia, Pa., January 24, 1913.

To the Editor of the American Engineer:

It has been your custom for several years to use a quantity which you term "equivalent heating surface" in connection with superheater locomotives. You explain this to be the evaporative heating surface plus 1.5 times the superheater heating surface. I do not understand how you arrive at the conclusion that superheater heating surface is 1½ times as valuable as evaporative heating surface. I understood Mr. Young to state at the December meeting of the A. S. M. E. that his tests indicated the superheater heating surface to be about one-half as valuable as heat absorbing surface as was the water evaporative surface. I believe that Mr. Hoffman also stated that the superheater heating surface was somewhat less efficient. If these are the facts I do not see what justification you have in using 1½ times the superheater heating surface. Pacific.

[Editor's Note: Our practice of using 1.5 times the superheater heating surface and adding it to the evaporative heating surface on superheater locomotives started shortly after the first locomotives having a high degree superheater was put in use in this country, and resulted from a desire to obtain a figure for heating surface of superheater locomotives which would permit their ratios to be compared directly with saturated steam locomotives. At that time the Canadian Pacific had more experience with this type of superheater than any other company, and Mr. Vaughan stated that his observations indicated that a locomotive having a high degree superheater with a surface equal to about ⅔ the water heating surface which its introduction required to be eliminated, would give practically the same power as the saturated steam locomotive. No elaborate tests had been made to check the figure and it was based largely on practical experience. Since that time there have been no data available that seemed to indicate this figure to be incorrect, although it is believed that it is exactly applicable only to certain particular conditions.

It must be understood in this connection that the locomotive is being considered as a whole and not the boiler alone. Mr. Young's statement applied only to the boiler and was based on the heat absorbing capacities of the different surfaces. The factor as we use it, however, also includes the action of the steam in the cylinders. Tests have shown that the superheater saves on an average of 25 per cent. of the water when delivering the same power. If we assume a case of a saturated steam locomotive where the steam consumption per indicated horsepower per hour is 26 lbs., the steam consumption for a high degree superheater locomotive of the same size, under the same conditions, would be 19.5 lbs. of water per indicated horsepower. At 1,500 horsepower this would require the boiler of the saturated steam locomotive to deliver 39,000 lbs. of water per hour and the boiler of the superheater locomotive to deliver 29,250 lbs. of water. If the saturated steam boiler had an actual evaporation of 10 lbs. of water per sq. ft. of heating surface per hour it would have 3,900 sq. ft. total heating surface. While it is probably not exactly accurate to assume that the evaporative heating surface of the superheater locomotive would have the same average rate per sq. ft., owing to the fact that a considerably larger portion of the surface is in the firebox which will give the same total evaporation in both cases and will thus require less to come from the tubes, the fact that most of the tube heating surface in a superheater locomotive is at the bottom of the boiler, which is probably less efficient than that at the top, there will be no great error introduced by assuming that the average rate per sq. ft. in the assumed case is also 10 lbs., which will give 2,925 sq. ft. of total evaporative heating surface in the superheater boiler. As a general average it is found that the ratio of the evaporative heating surface to superheater heating surface in modern boilers is about as 4.5 to 1, which in the assumed case would give a superheater having 650 sq. ft. of surface. If we then take 1.5 times this and add it to the 2,925 sq. ft. of evaporative heating surface we have a total of 3,900 sq. ft., or exactly the same as is in the saturated boiler.]

TIRE TURNING RECORD

Clifton Forge, Va., January 25, 1913.

To the Editor of the American Engineer:

I am enclosing a report of a driving wheel tire turning test which in my opinion is very good, and is hard to beat. The depth of cut was from ¼ in. to 5/16 in., and the feed was 9/16 in.

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
Diameter wheel, finished, in..	55⅜	55⅜	55⅜	55⅜	55⅜	55⅜	55⅜
Diameter wheel, rough, in....	56	56	56	56	56	56	56
Floor to chuck, minutes.....	10	10	5	5	5	7	8
Turning, minutes	32	27	22	25	18	33	31
Machine to floor, minutes....	7	5	3	4	3	6	4
Total time, minutes.....	49	42	30	34	26	46	43
Cutting speed, ft. per minute...	10 to 17	10 to 17	10 to 17	10 to 17	10 to 17	10 to 17	10 to 17

The test was made on a 90-in. heavy duty Niles-Bement-Pond machine, which is driven by a 50 h. p., d. c., Westinghouse motor. I would be glad to know of any one beating the time of 26 in. from floor to floor. E. A. Murray.

Master Mechanic, Chesapeake & Ohio.

Draft Timber Bolts.—An ample supply of draft timber bolts should always be kept on hand at car repair points. The time required to straighten and rethread old bolts may cause serious delay to important lading. If new bolts are always available the old ones can be fixed up at a more convenient time.

TESTS OF JACOBS-SHUPERT BOILER

Under Normal Conditions a Locomotive Firebox Without an Arch Evaporates 40 Per Cent. of the Water

The report of Dr. W. F. M. Goss on the comparative tests of a Jacobs-Shupert and a radial-stay boiler of identical size, which were made under his supervision, states that the evaporative efficiencies of the two boilers were found to be practically the same, but that the Jacobs-Shupert boiler demonstrated some advantages in the matter of capacity over the radial-stay boiler and was forced without the least sign of distress to an unprecedented rate of power. When fired at a rate of 6,553 lbs. of dry gas coal per hour and a rate of combustion equal to 115.35 lbs. of dry coal per square foot of grate area, it gave an equivalent evaporation per hour of 19.13 lbs. of water per square foot of heating surface and developed 1,669 boiler horse power, or an equivalent of one boiler horse power for each 1.8 sq. ft. of heating surface. The equivalent evaporation per pound of dry coal was 8.78 lbs. of water, or the evaporation of 7.35 lbs. of water from 68 deg. feed water. The over-all boiler efficiency under these conditions was 65.34 per cent., and of the boiler exclusive of the grate, 67 per cent.

This report shows that when a long flamed bituminous or gas coal was used the fireboxes of both boilers absorbed from practically 49 to 31 per cent. of the heat in the range of combustion from 1,600 lbs. to 4,400 lbs. of dry coal per hour. When using this kind of coal between these rates the percentage of the total heat absorbed by the firebox can be found by dividing the pounds of coal fired per hour by 190 and subtracting the quotient from 56. This applies to a firebox not fitted with a brick arch. In none of the tests of the firebox, as separated from the barrel, was the brick arch used. Tests were made to ascertain the effect of the brick arch on the boilers in their normal condition and this developed that with long flamed fuel the arch showed an increased evaporation per pound of coal of 12 per cent., and when using the short flamed bituminous coal the increased evaporation, due to the presence of the arch, was 8 per cent.

An investigation was made to determine some facts in connection with the circulation of the water around the firebox. These showed the rate of flow to be considerably less than had been anticipated and indicated that the opening in the stay plates of the Jacobs-Shupert firebox was sufficient to admit the water in ample quantities to all parts of the water leg. The tests were not extensive enough to develop accurately the presence of any definite currents.

The general results of the low water tests, which completed the series, have been published in these columns.* These resulted in the failure of the crown sheet of the radial-stay boiler at a time when the water level was 14½ in. below the top of the crown sheet, which occurred 17¾ min. after the water level had reached the crown sheet. The Jacobs-Shupert firebox, however, did not fail in any particular, although the water reached a point 25½ in. below the level of the crown sheet, 34 minutes after it had reached that level. The water level finally fell to nearly 40 in. below the crown sheet and the test was forced to a conclusion by the lack of sufficient steam to maintain the draft. An inspection of the boiler after the tests showed all the usual effects of overheating except that the firebox was intact. Three-quarters of the tubes were out of water and had sagged from the effects of the heat. Several had collapsed. There was some change in the curvature of the sections, but there were no local pocketing and no leaks between the sections. In preparing for this test the tubes of both boilers were welded to the back tube sheet. This test is believed to be a conclusive demonstration of the superior strength and safety of the Jacobs-Shupert firebox under low water conditions.

*See *American Engineer*, July, 1912, page 366.

OUTLINE OF TESTS.

For testing purposes the firebox end of a Jacobs-Shupert boiler was taken at random from a lot which were under construction for a railroad company. No effort was made to have the particular one chosen stronger or better than the others which were going through the shop. It was found impossible to obtain a radial-stay boiler of the same general dimensions as the Jacobs-Shupert boiler and therefore one was built especially for these tests by the Baldwin Locomotive Works. The construction was subject to the specifications and standards of the same railroad to which the Jacobs-Shupert fireboxes were being supplied. Both boilers were built in the presence of a personal representative of Dr. Goss. They were both of the extended wagon top type and had the dimensions shown in the following table.

	Jacobs-Shupert.	Radial stay.
Diameter at front end, in	70	70
Diameter at throat, in	83⅞	83⅞
TUBES.		
Number	290	290
Length, ft. and in	18—2	18—2
Diameter, in.	2¼	2¼
FIREBOX.		
Length, inside, ft. and in	9—1⅝	9—1⅛
Width, inside, ft. and in	6—4⅜	6—4¼
Depth, inside, ft. and in	6—1⅞	6—2⅛
Grate area, sq. ft.	58.14	58.07
HEATING SURFACE.		
Side and crown sheets, projected area, sq. ft.	146.2	146.6
Side and crown sheets, developed area, used in all computations, sq. ft.	168.0	146.6
Total firebox, sq. ft.	230.8	206.7
Tubes, sq. ft.	2,759.0	2,759.0
Total barrel, sq. ft.	2,777.6	2,777.6
Total boiler, sq. ft.	3,008.4	2,984.3

In the first series of tests, which are designated as Series A, each boiler was divided into two distinct compartments by the introduction of a partition between the firebox and the barrel. This partition was simply the back tube-sheet extended as a single flat plate to the wrapper sheet and the mud ring, and riveted in place between the firebox and the barrel. For the second series of tests, known as Series B, this partition was removed and the boilers were both in the normal condition. In re-tubing the boilers, after the reconstruction of their fireboxes, all tubes were welded in the tube sheets in anticipation of the low water tests. This was done since the tests were for the purpose of subjecting the crown of the firebox to conditions so severe as to bring about its failure and it was thought best to take every precaution to prevent a premature failure of the tube sheet.

The two boilers were mounted side by side in a special building on the grounds of the Lukens Iron & Steel Company at Coatesville, Pa. They were both equipped with the ordinary front end arrangement and stack, except that the usual netting was omitted. A standard exhaust pipe and tip was fixed to the bottom of the smokebox and suitable outside piping was provided to convey the steam generated by the boiler to the lower end of the exhaust pipe. This arrangement provided for a delivery of most of the steam generated through the exhaust tip, and the steam thus discharged provided the usual draft action on the boiler. The control of the draft was through the medium of a valve and a 7 in. pipe line which served the purpose of the usual locomotive throttle valve. The steam passing through it was reduced from the pressure of the boiler to that usually found in the exhaust pipe. Steam in excess of that required to produce the necessary draft was discharged through a 3 in. blow-off pipe, or through the safety valves.

In all tests the feed water first entered a large calibrated tank and the exact amount was recorded, after which it was discharged

to vats from which the injectors took their supply, there being a separate vat for each injector. In the Series A tests two injectors were employed, one feeding the barrel of the boiler through the usual check valve and the other feeding the firebox section through a check valve at the center of the back head above the crown sheet and an internal 2 in. pipe, perforated with ¾ in. holes, which continued over the top of the crown sheet nearly to the diaphragm between the two sections of the boiler. Water glasses were provided on both sections and the level in the two parts was kept as nearly as possible at the same height. All fuel, both oil and coal, was carefully weighed on calibrated scales. Other readings included records of the boiler pressure, the temperature and humidity of the laboratory and the outside air, temperature in the smokebox, draft both in front and back of the diaphragm, amount of steam used by the oil burner, and the quality of the steam in both the barrel and the firebox. The smokebox gases, the fuel and the ashes were all analyzed. No temperatures of the firebox are recorded.

Nine tests were made in Series A with oil as fuel, five on the Jacobs-Shupert and four on the radial-stay boiler, and twelve tests were made with coal, six on each of the boilers. Two kinds of coal were used, one known as Scalp Level coal which burns with a short flame and the other as Dundon coal which is a long flame gas coal. In Series A two tests were made on each boiler with Scalp Level coal and four with Dundon coal. Analyses of these coals are as follows:

	Scalp Level.	Dundon.
Fixed carbon, per cent	75.90	49.54
Volatile matter, per cent	16.45	34.34
Moisture, per cent	2.15	3.38
Ash, per cent	3.50	12.74

In the tests with oil the boilers were operated to give an equivalent evaporation of water in pounds per hour from 20,000 lbs. to 29,000 lbs. and over. It was shown by these tests that each pound of oil resulted in the evaporation of 15.9 to 13.2 lbs. of water per hour, the amount diminishing as the rate of power increased. The tests showed that when the Jacobs-Shupert boiler was made to give an equivalent evaporation of 20,000 lbs. of water an hour, it gave an equivalent of 14.14 lbs. of steam for each pound of oil burned. The later tests with coal showed that at the same rate of power it generated 8.3 lbs. of steam for each pound of Dundon coal burned. This indicates that 1 lb. of oil in locomotive service is equal to 1.7 lbs. of high grade bituminous coal. The tests showed that when 800 lbs. of oil were being fired per hour, 54 per cent. of the total evaporation was from the firebox surface, but when 2,200 lbs. of oil were fired per hour 40 per cent. of the total heat transmission was through the firebox. When giving an equivalent evaporation of 40,000 lbs. of water per hour for the whole boiler the evaporation per square foot of heating surface per hour for the firebox was 49.59 lbs. and for the barrel 6.47 lbs. The ratio of the heat absorbed per square foot by the firebox to that by the tubes when using oil fuel was as 7.6 to 1.

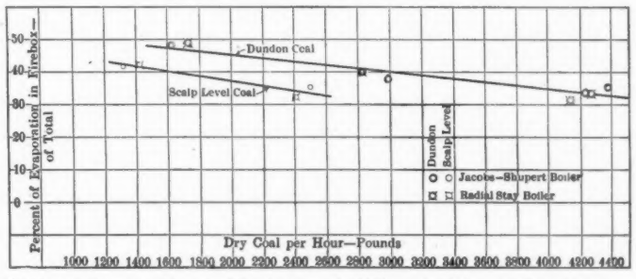
The deduced values covering the firebox performance were obtained by multiplying the evaporation actually obtained by the ratio of the total firebox surface to the firebox surface effective in producing vaporization in the firebox-end of the boiler. The small increment, which by this correction is added to the observed evaporation of the firebox, is in the deduced results, subtracted from the observed evaporation of the barrel. The effect of this correction is merely to credit to the firebox and debit to the barrel the heat transmitted by the back tube-sheet.

Considerable difficulty was encountered in so maintaining the fire as to prevent deposits of soot on the heating surface, and Dr. Goss states: "The results cannot be accepted as constituting a basis of comparison which admits of a high degree of refinement and for this reason no attempt was made to elaborate through a complete heat balance, the computations of the oil-fired tests."

In the Series A tests with coal, either boiler gave an equivalent evaporation of more than 10 lbs. of water per pound of coal at low rates of power. For the whole series of tests, the evaporation was normally above 8 lbs. of water per pound of coal. This indicates that the thermal efficiency is from 8 to 10 per cent. less when coal is fired than when oil is used as fuel. In this connection, however, it should be noted that these fireboxes were not fitted with brick arches which later tests showed will increase the boiler efficiency from 8 to 12 per cent. when using coal.

The percentage of the total heat absorbed by the boiler, which is taken up by the firebox when burning coal, is shown in the accompanying diagram. The difference of the two kinds of coal is clearly evident in these curves and amounts to about 8 per cent. On the basis of an equivalent evaporation of 20,000 lbs. of water, the percentage of total heat absorbed by the boiler, which is taken up by the firebox of the Jacobs-Shupert design, is 42 per cent. with oil, 42 per cent. with Dundon coal and 35 per cent. with Scalp Level coal. This suggests a possibility of some relation between the character of the fuel and the amount of heat absorbed by the firebox. For example, it may be that the substitution of anthracite coal for bituminous coal would reduce the work done by the firebox below 35 per cent. On the other hand, it may be that the freer burning coal deposits less soot in the tubes and permits them to absorb a larger proportion of the total heat delivered.

When Dundon coal was being fired at a rate of 4,341 lbs. an hour, the Jacobs-Shupert boiler gave an equivalent evaporation



Ratio of Evaporation in Fireboxes at Different Rates of Combustion.

of 35,405 lbs. of water per hour, of which 11,982 lbs. was evaporated from the firebox and 23,423 lbs. from the tubes. The whole boiler developed 1,026 horsepower, of which 304 horsepower was developed by the firebox. The average rate of equivalent evaporation per square foot of heating surface per hour for the whole boiler was 11.77 lbs., and the firebox alone had 51.92 and the barrel 8.43 lbs. The ratio of heat absorbed by the firebox to that absorbed by the tubes was as 6.15 to 1.

In figuring the evaporation for the Jacobs-Shupert firebox, the developed area of the surfaces is used, which makes it about 11 per cent. more than the radial-stay firebox, although the projected area of the two are the same. Dr. Goss concludes from the results of twenty tests that the difference in absorbing capacity of the two types of fireboxes tested is not sufficient to be established by carefully conducted boiler tests.

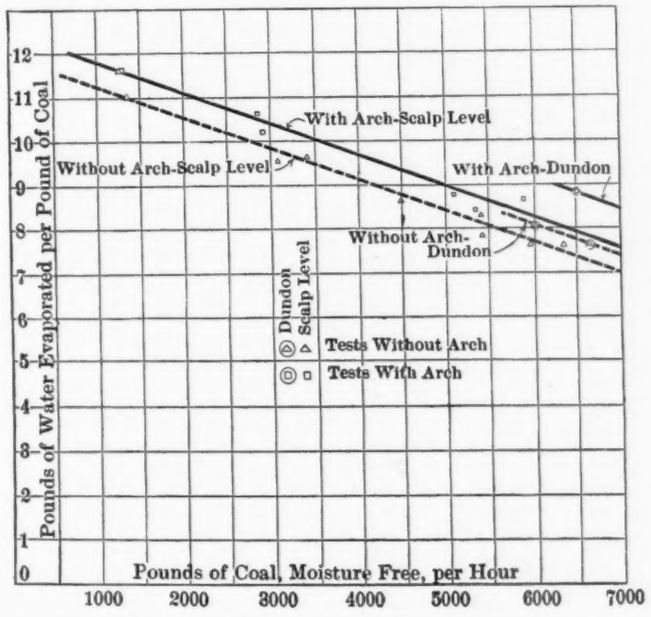
In Series B there were eleven tests run on the two boilers without a brick arch and eight with the brick arch. There were five tests of the Jacobs-Shupert and four of the radial-stay without the arch fired with Scalp Level coal and one test of each boiler under the same conditions fired with Dundon coal. The tests with the arch installed were all with Scalp Level coal with the exception of one test on the Jacobs-Shupert firebox when Dundon coal was used. The accompanying diagram shows the rates of equivalent evaporation both with and without the arch.

In all tests the efficiency of the boiler was highest when the power developed was the least. For instance, with the Jacobs-Shupert boiler burning 1,389 lbs. of dry coal an hour, the efficiency was 71.86 per cent., or 79.75 per cent. excluding the grate. When the same boiler was burning 6,314 lbs. of dry coal an hour the efficiency was 50.41 per cent., or 55.36 per cent. excluding the

grate. The boiler horsepower was 443 and 1,393 respectively, and the equivalent evaporation per square foot of heating surface per hour was 5.08 and 15.98. The precise effect produced by increasing the load on a boiler is well shown by the values of the heat balance for the several tests run with Scalp Level coal, as shown in the following table. These are all for the Jacobs-Shupert boiler.

Pounds of coal fired per hour	1,389	3,419	5,930	6,314
Thermal units for each pound of coal:				
Absorbed by water in boiler	10,687	9,327	7,532	7,388
Lost by moisture in coal	48	34	37	33
Lost by moisture in air	49	53	114	64
Lost by hydrogen in coal	486	497	500	514
Lost by smokebox gases	1,979	2,731	3,992	4,675
Lost by incomplete combustion	78	...	...	...
Lost by cinders passing up stack	153	851	1,078	1,012
Lost by combustible in ash	1,187	679	291	185
Lost by radiation and unaccounted for	205	547	881	783
Total B. t. u. per pound of coal	14,872	14,719	14,425	14,654

The tests with the arch in place gave an efficiency above the others in about the proportion indicated in the diagram. When



The Effect of the Brick Arch on Evaporative Efficiency.

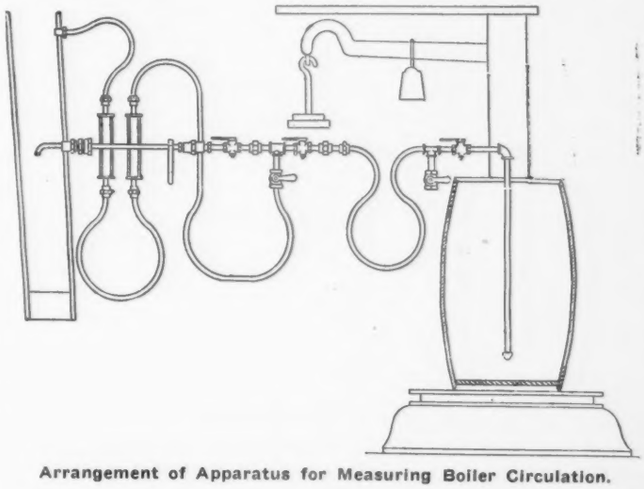
burning 1,367 lbs. of dry coal an hour and giving an equivalent evaporation of 5.21 lbs. of water and a boiler horsepower of 455 the over-all efficiency was 74.82 and the efficiency excluding the grate was 78.85. When burning 5,887 lbs. of dry coal an hour with an equivalent evaporation of 17.21 lbs. per square foot and a boiler horsepower of 1,500, the over-all efficiency was 57.90 and an efficiency excluding the grate 61.27. The report states that the results of the Series B tests show that the Jacobs-Shupert boiler and the radial-stay boiler under all the various conditions of the test operated at practically the same efficiency. The conclusions regarding the application of the arch are given in the opening paragraphs.

CIRCULATION TESTS.

For the tests to determine the rate and direction of the circulation of the water around the Jacobs-Shupert firebox, George L. Fowler devised the apparatus which is shown in outline in one of the illustrations. A Pitot tube was inserted through a 1 in. hole in the side water leg, being arranged so that its nozzle could be turned in any direction and located at any desired distance from the firebox sheet. Through suitable connections this was connected to a manometer formed of two water glasses, as shown, which was filled with tetrachloride of carbon, colored red, whose specific gravity was exactly 1.6. Thus by turning the tube and observing the effect on the manometer level, the direction of the circulation at that particular point could be ascertained. After this reading was taken, the valve connecting to the manometer was closed and another valve was opened, which allowed the mixture of steam and water entering the tube to flow into the water, partially filling the barrel calorimeter. Having a record of the temperature ranges before and after the admission of the liquid from the boiler to the calorimeter and the pressure existing at the time as registered from the steam gage, it was possible to determine the percentage of steam and water in the mixture as it existed at the mouth of the Pitot tube. From this the specific gravity of the mass could be calculated. Having then the head produced by the difference in the levels of the tetrachloride of carbon in the manometer and the specific gravity of the liquid whose impact caused that difference of level, the velocity of the liquid can be calculated.

Fifteen holes were drilled in the outside sheets of the fireboxes in preparation for this test. The Jacobs-Shupert firebox had eleven sections and the holes were located in three rows; the bottom row being 21 in. above the bottom of the mud ring, the next row 24 in. above the first and the third row 24 in. higher still, which brought it at the turn where the side sheet joins the crown. These holes were located in sections 1, 3, 6, 8, and 10, section 1 being at the front end of the firebox. They were numbered consecutively beginning at the front end of the top row and continuing toward the back of the firebox in each row. Thus holes Nos. 1, 6, 11 were the top, center and bottom holes of the front section and Nos. 5, 10 and 15 were in the tenth section or the second one from the back head. The holes in the radial-stay firebox were at the same relative location.

Unfortunately the time allowed for this work only permitted observations to be taken at holes 3, 7, 8, and 12 of the Jacobs-Shupert boiler and holes 3, 8, and 12 of the radial-stay boiler. Records were taken at 1 in. and 2 in. from the inside sheet for all of the holes and at 3 in. and 4 in. for part of them in each boiler. The results as to direction are shown graphically and as to velocity both graphically and numerically in the illustration. The figures for velocity are in feet per second. Mr. Fowler states in the report that, "the record of the angle of flow must not be taken as positive or fixed." The observations for the



Arrangement of Apparatus for Measuring Boiler Circulation.

direction of the flow were not taken simultaneously with those for velocity; in fact, he makes it clear that the work done in this connection is to be accepted only as the beginning of the solution of a very complicated problem. Dr. Goss' report states in this connection that notwithstanding the limitations that must be placed about them, these results constitute a distinct contribution to the sum of knowledge and are of tremendous significance. They show almost the complete absence of any fore and aft movement of the water. There is no evidence to show that the water in the bottom of the boiler is pushing backward and in the upper part forward, and the observations seem to prove that

enough water passes back from the barrel to the water legs of the boiler to make good that which the firebox evaporates, and no more.

This conclusion was confirmed by the experience gained in running the evaporative tests of Series A. In this case, whatever circulation there was in the barrel could only involve the water in that section and there was absolutely no chance for the longitudinal movement of the water, and yet, under this condition, not the least difficulty was experienced in working the rate of evaporation up to more than 10 lbs. of water per square foot of heating surface per hour; that is, to a rate of power which on the road would be recorded as normal. Dr. Goss concludes from this that the ports in the stay sheets of the Jacobs-Shupert boiler have a very minor function to perform, and as they are now designed they not only are entirely sufficient, but the thermo dynamic performance of the boiler could not suffer in any way even if they were reduced to a small percentage of their present area.

In discussing the results, Mr. Fowler says that he believes that there is a regular slow movement from front to back, broken throughout its whole course by violent agitation and innumerable cross currents, but that in no place are these currents torrential, nor is the stream movement itself very rapid, but that in some places there is a true circulation, the water following a definite

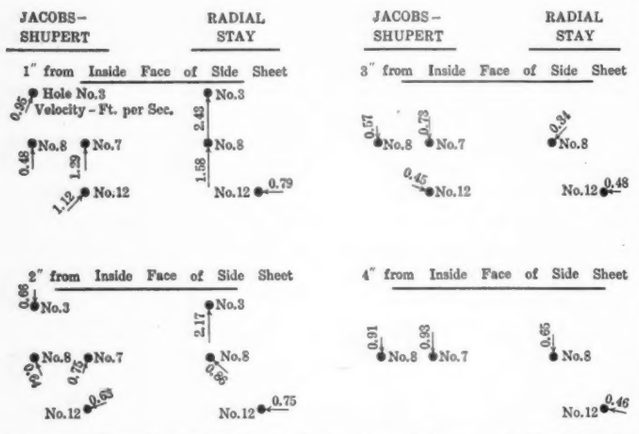


Diagram Showing Direction of the Circulation and Velocity in Feet Per Second.

path returning to a previous position. An example of this is found in one of the tests at hole 8. At 1 in. from the inside sheet there was an upward flow of 1.71 ft. per second; at 2 in. the flow was still nearly vertical; at 3 in. there was a neutral point at which no movement could be detected, while at 4 in., or near the outer sheet, there was a vertical movement downward. The same thing is seen in the Jacobs-Shupert firebox at holes 7 and 8, but without the indication of the neutral zone devoid of flow.

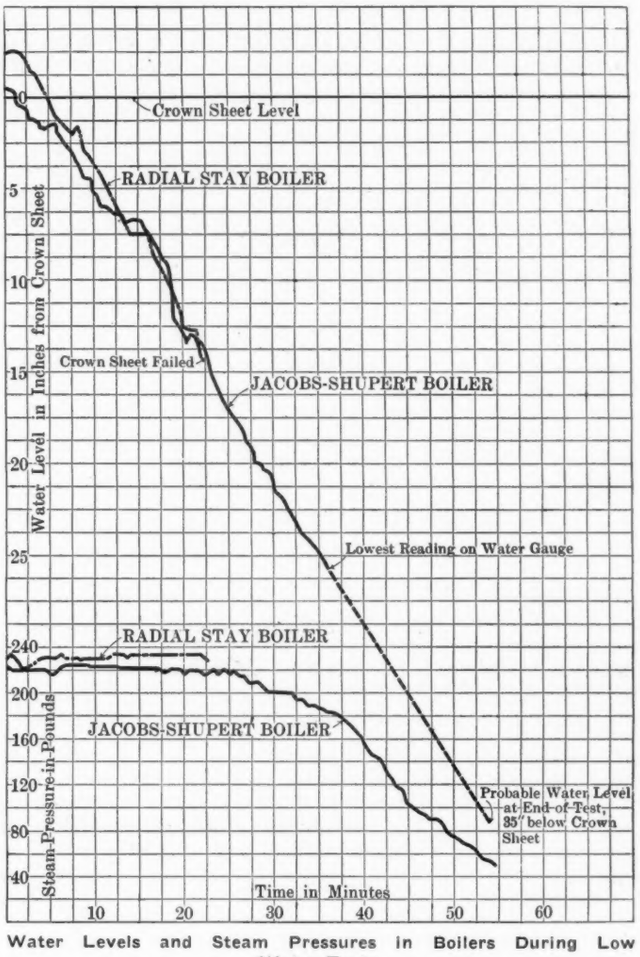
So far as the tests showed there was no indication of eddy or reverse currents in the radial-stay boiler. The movement is either vertical or back from the front to the rear, while in the Jacobs-Shupert firebox there was one hole where the movement was from the back to the front, evidently due to eddies set up by the stay plates.

In order to ascertain the likelihood of there being a straight flow of cold water from the front to the rear over the top of the foundation ring, a thermometer was placed at the back lower corner of the Jacobs-Shupert firebox. Feed water at a temperature of about 70 degrees was being used at the time and while the boiler was working at 215 lbs. steam pressure the observed temperature at that point was 380 deg. or only 13 deg. below the boiling point at that pressure. In connection with these circulation tests it should be remembered that both boilers at the time of making the tests were fitted with two arch tubes.

LOW WATER TESTS.

A general account of the low water tests with photographic illustrations was given on page 366 of the July, 1912, issue of the *American Engineer*. The boilers mounted on a fill some distance from the works of the Lukens Iron & Steel Company were arranged for firing with oil. The control of the fuel, the draft pressure and the feed water was centered in a bomb proof about 200 ft. from the nearest boiler. Water glasses were arranged for reading to a point 25½ in. below the crown sheet and records of the water level and steam pressure were obtained by means of telescopes on the top of the bomb proof.

The Jacobs-Shupert boiler was tested first and 53 minutes after the water had reached the level of the crown sheet the test was discontinued for the lack of sufficient steam to maintain



Water Levels and Steam Pressures in Boilers During Low Water Tests.

the draft. At this time 78 per cent. of the water in the boiler had been evaporated and the level was estimated to be about 35 in. below the crown sheet. Since the gages were arranged only for reading at 25½ in. below the crown sheet, its exact level could not be obtained. At the beginning of the test the conditions were arranged so as to provide for the evaporation of 10 lbs. of water per square foot of heating surface per hour, an equivalent of 30,000 lbs. of water an hour. This amount naturally continued to decrease as the test progressed. The steam pressure at the end of the test was 50 lbs. Graphical records of the water level and steam pressure for both boilers are shown in one of the illustrations.

At the completion of the test of the Jacobs-Shupert boiler the radial-stay boiler was put in operation and tested under exactly similar conditions. This boiler continued to operate for about 18 minutes after the water had reached the level of the crown

sheet and finally failed with the water 14½ in. below the crown sheet. The failure was due to the pocketing of a considerable section of the crown of the boiler. The sheet itself, however, was not ruptured and the contents of the boiler escaped through the staybolt holes, the aggregate area of which was found to be approximately 186 sq. in. The explosion blew the brick arch in all directions, forced down one of the arch tubes and displaced the whole boiler for a distance of about 8 in.

A detailed inspection of the Jacobs-Shupert boiler after the tests were completed showed a well defined line running around the firebox approximately 34 in. below the crown sheet. Portions below this section were soot covered and normal in appearance. Higher up and in more exposed sections of the firebox the sections had the appearance of freshly heated steel. Between these two sections was a belt 5 in. in width which was generally reddish brown in color. The hottest sections in the whole boiler were found to be at the center of sections 5 and 6, while sections 9, 10 and 11 did not appear to be as highly heated as the remainder of the upper section of the box. The sections most affected disclosed a curvature which dropped ½ in. more than that which was originally given them. The change in contour, while not entirely regular, disclosed no evidence of a disposition to develop pockets or to local failure by blowing out. It was noted that notwithstanding the temperature to which the firebox was subjected the color of newly heated metal nowhere extended to the stay sheet, nor was there any point on the calking edge of the stay sheet which had been heated beyond that temperature which results in the reddish brown color. There was no evidence of any leaking in the crown sheet.

The tube sheet was found to retain very nearly its original shape with the exception of a small area on either side of the center, near the middle of the heated zone, which was unsupported by tubes and the plate here was bulged to the extent of ¼ in. A small leak was discovered at the top of the tube sheet where it joins the first section. The joint here was made with a copper calking strip. Four of the tubes were found to have collapsed just inside of the tube sheet; 14 others were pulled apart inside of the sheet. The welds between the tubes and the sheet were not disturbed in any case. It is probable that the actual rupture occurred in the process of cooling off after the test had finished. All tubes within the heated zone were found deflected downward, the deflection varying from a comparatively small amount to an amount equal to the diameter of the tubes. Tubes below the final water line remained in their original straight condition. There was no distortion or evidence of leaky staybolts on the door sheet and the arch tubes and arch were in perfect condition. It is reported that at the conclusion of this test the boiler, so far as the firebox construction was concerned, was in condition for operation.

On the radial-stay boiler, the section of the crown sheet that failed comprised 188 crown stays and staybolts. The button headed stays failed by the stays breaking inside of the sheet and the flat headed stays pulled through the sheet. Both side sheets with their stays were in perfect condition, no evidence of leaky staybolts appearing. The same is true of the door sheet and side sheets and the tubes appeared to be as secure as when originally welded in place. No tube was found to have been sufficiently heated to sag.

As a result of this test Dr. Goss concludes that the superior strength of the Jacobs-Shupert boiler permits it to be unduly overheated without failure for long periods of time, where the normal radial-stay boiler quickly fails and that where the overheating is so severe that it cannot be resisted, the result will be a blowout and not a disastrous explosion.

COAL.—The total amount of bituminous coal produced by American mines from the beginning of the industry to the end of 1911 is 6,468,773,690 short tons, and the total production of both anthracite and bituminous coal is 8,739,572,427.

MOVING PICTURES IN RAILWAY EDUCATIONAL WORK

Several years ago the Union Pacific established an Educational Bureau for the purpose of giving its employees an opportunity to increase their knowledge of railroad work through the medium of correspondence courses. This same system has also been adopted by the Illinois Central and the Central of Georgia, and in each case has been taken advantage of by about 10 per cent. of all the men employed by these roads. While this proportion may seem small it should be understood that the work is wholly optional with the men, and that at its best it can only be given in an abstract form which lacks the personal element of instruction so necessary to most students. The Educational Bureau, not feeling satisfied with this small percentage, has been endeavoring to work out a supplementary system of education that would interest the other nine-tenths.

Experiments were begun with moving pictures about a year and a half ago by D. C. Buell, chief of the Educational Bureau, to ascertain if they could not be adapted to railroad educational requirements successfully. The prohibitive cost of having moving pictures taken by professional operators pointed out the necessity of developing the moving picture work as a part of the Educational Bureau work, and consequently a moving picture camera was purchased and experiments were started which resulted satisfactorily. About 2,200 ft. of film was exposed, showing the story of fuel economy and the proper and improper method of firing locomotives. These films were first exhibited in connection with a paper by Mr. Buell at the annual meeting of the International Railway Fuel Association at Chicago in May, 1912. Since that time additional pictures have been taken to round out the story and the film has been considerably shortened and in its present state consists of about 1,500 ft.—enough to occupy about 30 minutes if run through the projection machine without stopping.

Stereopticon lantern slides, colored to represent the different conditions of fires, tabular matter, and other data have been added, and about the first of October the Board of Examiners' car on the Union Pacific, which was idle at the time, was fitted with the moving picture projection machine and started over the road in charge of a lecturer who was accompanied by the fuel supervisor of each division. Lectures were given three times a day, and from the start a great deal of interest was manifested in this method of instruction, not only by the firemen and engineers, but by men in other classes of service as well. The car has been crowded almost from the first day it was started out over the road. There have been a number of times where eight or ten of the engineers or firemen brought their wives down to the lecture with them.

As an indication of the impression this work makes, the managements of several of the electric light companies who have furnished the current for the operation of the projection machine at different towns have asked permission to send the engineers and firemen of their plants to attend the lectures, and in each case they have refused to charge for the electric current used on account of the economy they felt their own men would manifest from attending the lecture.

There has been a noticeable decrease in the amount of smoke made around terminals and on the road, as well as the amount of time that the engines pop off. This is so noticeable that it is commonly remarked by conductors, trainmen, yardmen and others. One engine watchman who was tending a locomotive which was used to heat a passenger train nights at an intermediate point, reported that he had burned 5 tons of coal a night until he attended the lecture, and that he never burned over 3 tons a night thereafter.

Officers state that no work of an educational nature that has ever been done has created the discussion or caused the interest being manifested in this moving picture work; the road fore-

men of engines and fuel supervisors report a noticeable reduction in the amount of fuel used in getting trains over the roads; engineers report a saving of over half on some runs. It is too early as yet to give out any comparative statistics of fuel performance on the divisions that have been covered by the car, although the results of the work will be reflected in the fuel statements.

The original moving pictures were taken with a dummy firebox, consisting of a door sheet, flue sheet, arch tubes, arch and grates of a boiler, and a man then demonstrated the proper and improper use of the scoop shovel by firing into this dummy firebox, showing the extra labor caused by stiff-backed, or jerky firing; the ease of firing with a swing; the bad effects of holding the scoop at the wrong angle, throwing the coal over the arch, striking the arch and forming a bank, failing to get coal up under the flue sheet, firing unevenly, thus causing banks, etc.

This series of pictures is followed by a picture taken looking down on to the deck of an engine and showing the fireman actually at work firing. The pictures were taken with the fireman on the helper engine pushing a tonnage train up a hill. The first series of pictures shows a good fireman firing according to the correct principles, and the second pictures a poor fireman firing improperly and uneconomically. This second picture includes baling in the coal, not closing the door between fires, throwing off the lumps instead of breaking them up, shoveling off the slack coal instead of burning it, shaking the grates excessively, hooking the fire repeatedly, and making volumes of black smoke and very little steam. The saving in labor due to proper firing is plainly noticeable.

The next picture shows the waste of coal due to an engine popping off, a man standing on the ground transferring a scoop of coal from one platform to another each fifteen seconds while the engine is popping off, indicating a waste of coal of 60 lbs. or more a minute due to the engine popping.

Other pictures show an engine just in off the road having the fire cleaned. It was cleaned on the ground instead of into the cinder pit, so that as the engine pulled away the great mass of burning fire which was dumped out could be plainly seen, indicating the enormous waste due to firemen not being careful to burn down the fire properly in approaching a terminal. One shows the waste of coal due to filling the tank of an engine too full when coaling it, some of the coal falling off the tank as the engine moved away from the chute. Another picture shows the work of a good fireman and a poor fireman, the camera being set up on the rear of the observation car of a passenger train, showing the graduations in smoke from the clear landscape to one so thoroughly obscured by black smoke as to blot out all the scenery.

The closing picture of the series is a view of a double header handling a tonnage freight train up grade, the fireman on the first engine firing correctly, making practically no black smoke and keeping the engine hot; the fireman on the second engine firing incorrectly, fogging up the whole country and having an uncertain steam supply. This picture was taken by hauling a car, on which the moving picture camera was mounted, up the hill ahead of the double header. The picture is so realistic that one cannot doubt that the man firing the second engine wasted as much coal going up the hill as the first man burned. Very little lecturing is required to tell the story, and it leaves an impression on a man's mind that makes him go out and try the recommended methods of correct firing and demonstrate to himself the labor saved and the economy effected thereby. A complete account of these moving pictures can be obtained from the secretary of the International Railway Fuel Association.

The work done so far has demonstrated plainly that practically every employee of the railroad is interested in instruction work of this kind. It is a certain way to reach "the other nine-tenths," with instructive and interesting information. There is one feature, however, that must be watched, and that is, the pictures must be absolutely practical. The slightest variation from good practice is picked out and criticized by the men who attend the car. It has been the experience of those on the car that the men come back to as many lectures as they can spare time to attend.

The problem of taking moving pictures is an intricate one, and should not be attempted by an amateur. The cost where the outfit is owned and operated directly, as in the case of the Union Pacific, is very reasonable; in fact, the Union Pacific is equipped to take any class of moving pictures for educational work, and has already had requests from a number of outside concerns and other roads for assistance in this line. The cost of a projection machine to show the films after they are taken runs from $150 to $225. A common passenger coach can be made ready for the instruction work at a cost of not over $25.

Fuel moving pictures are now being shown by the Educational Bureau on the Illinois Central and Central of Georgia as well as on the Union Pacific. Other films are being planned for as soon as the fuel lectures are completed. The proposition of loss and damage to freight is being prepared in story form, the safe transportation of explosives being touched on in the same film. A "safety first" film is being worked out; a film showing proper maintenance of signals is being planned, and quite an elaborate picture story of the cost of waste of time will also be worked up at an early date. There is no doubt but that moving pictures staged and taken by practical railroad men will create and hold interest, more than any other kind of railroad educational work.

CURVES OF LOCOMOTIVE OPERATION

By L. R. POMEROY

On the opposite page is given a diagram showing the relation between heating surface, evaporation per sq. ft., maximum tractive effort, speed in miles an hour, and fuel consumption per hour at different rates of evaporation per pound of coal. These are shown for both saturated and superheated steam locomotives

The highest speed at which a locomotive will maintain its maximum tractive effort is readily found from this diagram if the probable rate of evaporation is known. In the example shown by the heavy dotted lines, a saturated steam locomotive having 4,000 sq. ft. of heating surface and a maximum tractive effort of 50,000 lbs. can maintain it at 10 miles an hour if a rate of actual evaporation of 10 lbs. per sq. ft. of heating surface is obtained. At this rate the fuel consumption will be about 6,700 lbs. an hour if the boiler gives 6 lbs. of steam for each pound of coal, or 5,000 lbs., if it gives 8 lbs. of steam per pound of coal. If the same locomotive has a superheater giving 200 deg. superheat and still has an evaporation of 10 lbs. of water per sq. ft. of evaporating heating surface, it will maintain its maximum tractive effort up to nearly 13½ miles an hour. The fuel consumption will, of course, be the same in both cases.

The curves may be used also for finding the rate of evaporation, from any known heating surface for any speed at full tractive effort, or the required amount of heating surface at any assumed rate of evaporation. The fuel consumption at any speed and tractive effort will be found by following horizontally from their intersection to the scale at the right for a saturated steam locomotive and to the one on the left for locomotives having superheaters.

These curves are based on a mean effective pressure equal to 85 per cent. of the boiler pressure and are governed by formulas derived as follows:

Let D = diameter of drivers in inches.
d = diameter of cylinders in inches.
s = stroke in inches.
w = weight of a cubic foot of steam at the assumed mean effective pressure.
P = steam pressure in the boiler.
H. S. = total heating surface in square feet.
r. p. m. = revolutions per minute of the drivers.

The total pounds of steam per revolution of the drivers equals

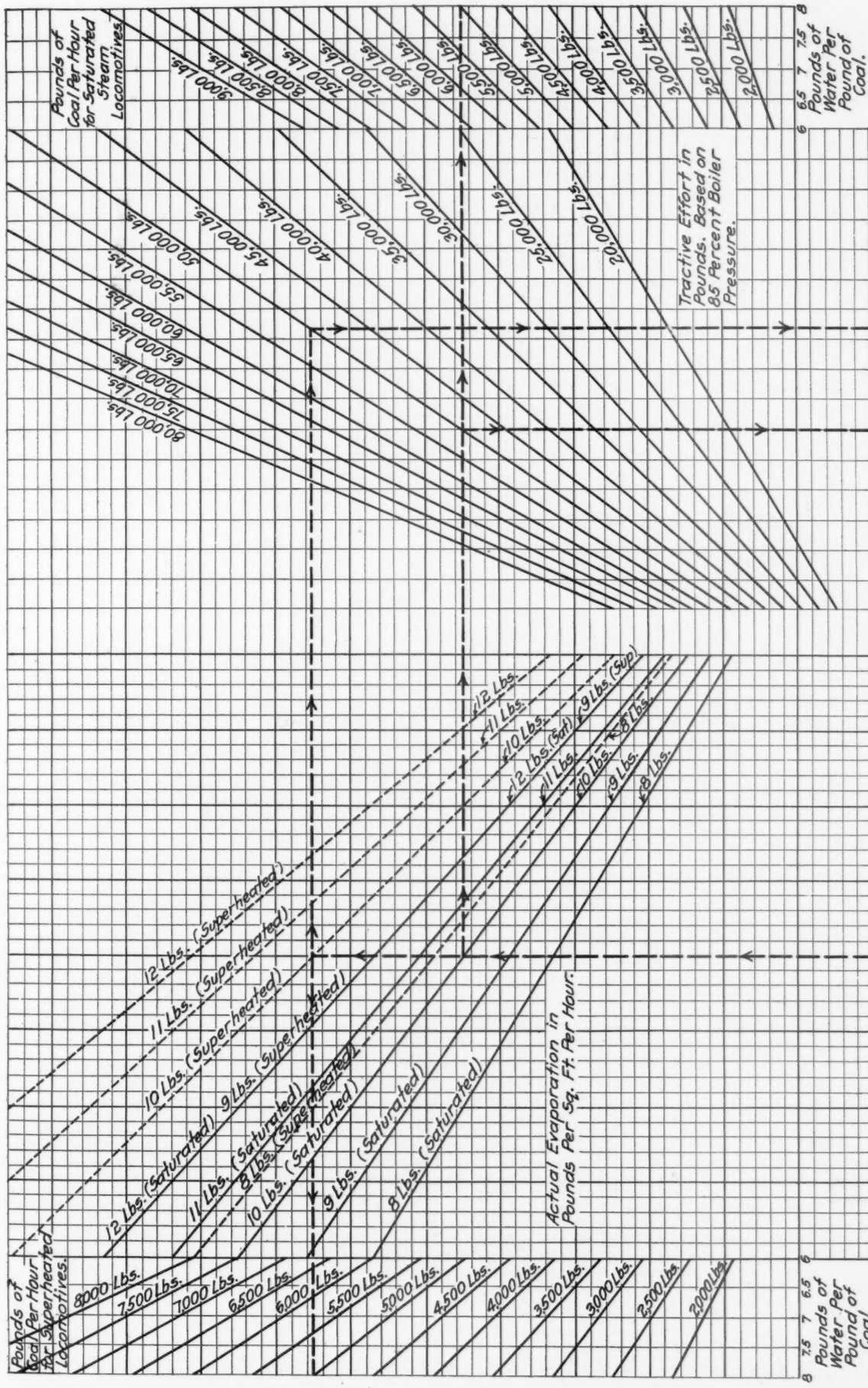


Diagram for Determining the Relation Between Maximum Tractive Effort, Speed, Heating Surface, Evaporation and Fuel Consumption of Saturated and Superheated Steam Locomotives.

four times the cylinder volume in cubic feet times the weight of steam per cubic foot at the mean effective pressure or

$$\text{Total steam per revolution} = .00182\ d^2\ s\ w$$

$$\text{Miles per hour} = \frac{D \times r.\ p.\ m.}{336}$$

$$= \frac{.85\ P \times d^2 \times s \times r.\ p.\ m.}{336 \times T.\ E.}$$

$$r.\ p.\ m. = \frac{m.\ p.\ h. \times 336 \times T.\ E.}{.85\ P \times d^2 \times s}$$

$$\text{Total pounds of steam an hour} = \frac{36.65 \times m.\ p.\ h. \times T.\ E. \times w}{.85\ P}$$

The total pounds of steam an hour equals the square feet of total heating surface multiplied by the rate of evaporation and by equating, the formula will be reduced to

$$m.\ p.\ h. = \frac{x \times H.\ S.}{T.\ E.}$$

For saturated steam locomotives at the different rates of actual evaporation:

For 8 lbs., x = 99.4
9 lbs., x = 112
10 lbs., x = 124
11 lbs., x = 137
12 lbs., x = 149

For superheated steam locomotives, taking w as the weight of a cubic foot of steam at the mean effective pressure and having 200 deg. superheat:

For 8 lbs., x = 130
9 lbs., x = 149
10 lbs., x = 166
11 lbs., x = 184
12 lbs., x = 198

The curves for coal consumption are based directly on the total amount of steam per hour.

Pounds of coal per hour = T. E. x m. p. h. x Z

For saturated steam locomotives at

7 lbs. of water to a pound of coal, Z = .0115
8 lbs. of water to a pound of coal, Z = .01006
9 lbs. of water to a pound of coal, Z = .00894

For superheated steam locomotives

At 7 lbs., Z = .00866
8 lbs., Z = .00758
9 lbs., Z = .00673

These formulas give a water rate of 25.1 lbs. of steam per indicated horse power for saturated steam locomotives and 20.6 lbs. for superheated steam locomotives.

TESTS OF SPRING STEEL

A fibre stress of 256,000 lbs. per sq. in. at the elastic limit was obtained in some recent tests on spring steel made at the McKees Rocks, Pa., works of the Crucible Steel Company of America. This result was given by chrome-vanadium steel, the pieces tested being taken from a pile of spring leaves shaped and tempered ready for the application of the bands. The springs were being manufactured for one of the large railways for service on unusually heavy locomotives.

The pieces selected measured 6 in. x ⅜ in. in section and the length between centers in the testing machine was 18 in. Successive loads, increasing by increments of 1,000 lbs. were applied to the center of each of the leaves selected. On the first test the leaf had a free height of 2¾ in. and at a load of 3,500 lbs. the elastic limit was reached. The corresponding fibre stress was 223,500 lbs. per sq. in. The second leaf tested had a free height of 1 11/16 in. and the elastic limit was reached with load of about 4,000 lbs., the fibre stress being 256,000 lbs. per sq. in. In the third test the leaf developed a fibre stress of 191,750 lbs. at the elastic limit.

In each case the tests were continued until the leaves cracked, which took place with a load of from 11,000 lbs. to 12,000 lbs. At this time all of the leaves were bent to angles of more than 90 deg. and in one case the test piece was bent to an angle of 117 deg. before it cracked.

THE DIVISION MASTER MECHANIC

Most engine house foremen look on a visit from the master mechanic with dread, as something to be gotten over with as quickly as possible. If they can get knowledge of his coming beforehand there is a scramble to get things cleaned up before he arrives. If he drops in unexpectedly they make the best of it, and heave a sigh of relief when he is gone.

This is a feeling that could be largely overcome by more frequent visits of the master mechanic. Instead of being tied down to his desk, doing office work that could just as well be done by an assistant, and depending largely for his knowledge of road conditions on his traveling engineer, he should himself get out over the road and study conditions at first hand. There is on many roads a lack of sympathy between the master mechanic and his foremen, largely due to the relations between them being carried on mainly by correspondence. A letter is, at best, a poor means of getting in close touch with a man, and many cases of foremen not making good can be directly laid to their not receiving personal encouragement from their superiors.

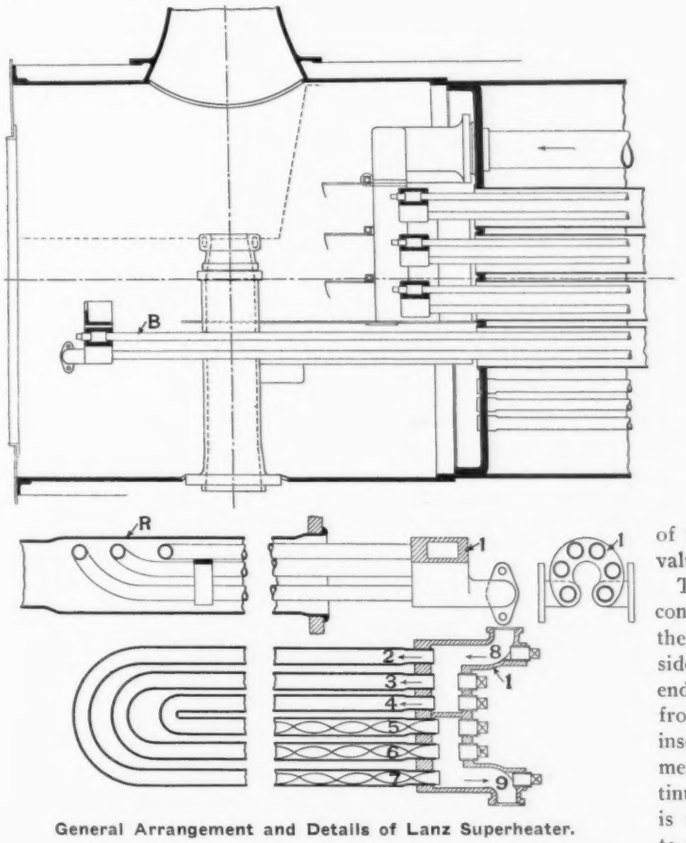
A man selected for a position as foreman is called to the master mechanic's office, given a rough idea of the conditions existing at the shop or engine house of which he is to have charge, and is told what is expected of him. A circular is issued announcing his appointment and he starts in with the idea that it is all up to him and that he must go it alone. He may have all the other qualities requisite in a good foreman and lack diplomacy, in which case he will probably get into an altercation with the transportation officials. Reports begin to reach the master mechanic's office and are passed on to the foreman with a request to "please explain." The master mechanic is busy; he has many demands on his time and when he finally has to get around to giving personal and close attention to the case of this particular foreman, it has got to a point where a change is the only remedy.

There are a number of points from which the division master mechanic's duties may be considered and improvements suggested. First, he needs a competent office assistant. This does not mean a chief clerk, but a man who has practical mechanical knowledge and is fitted to have the title of assistant master mechanic. His duties need not be confined to the office, but he should be available as head of the master mechanics' office when that official is away. A chief clerk is very necessary in a railroad office, but signing the name of his chief to letters should not be among his duties, nor should he, if he is not a man with a mechanical training, be allowed to deal directly with correspondence concerning strictly mechanical matters.

With such an assistant to depend on, the master mechanic is at liberty to get out over the road much more frequently. He can ride on engines with his traveling engineer and see for himself just what the latter's troubles are, and what he is doing to overcome them. Frequent visits to the various engine houses are possible, and he can get in close touch with his foremen, hear from their own lips what their difficulties are, make suggestions as to remedies and as to changes in methods and organization. If he finds that one man has a particularly good way of handling a certain piece of work he can tell the others about it, so that they can try it out. In short, he can cultivate a family feeling amongst all the foremen on his division and encourage them to work in harmony. This feeling can be materially increased by periodical meetings at which all the foremen are present. If one man has an idea that his neighbor at the next station is shirking work on engines and throwing it back on him, he has an opportunity then to air his grievance and hear the other fellow's side.

The trouble between the mechanical and operating departments is one that is as old as railroading itself. Engine house foremen get the idea that superintendents and trainmasters are sitting up nights thinking out ways to make it hard for the mechanical department men; and trainmasters think that if they only had a

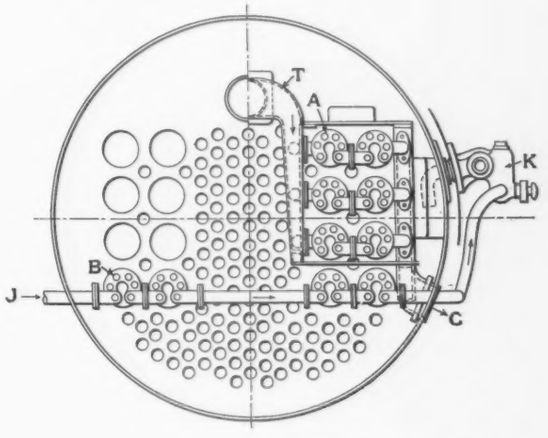
mechanical department that knew a little about railroading they could handle the traffic pretty smoothly. Coming right down to the base of the difficulty, it is probable that both are to blame to some extent for the reason that one side does not try to understand and co-operate with the other. Instead of trying to work in harmony, one side giving a little here, the other side a little there, it is "my engines" on the mechanical side, and "my trains" on the other side. The division master mechanic has it in his power, to a great extent, to overcome this feeling. He is as much an operating as he is a mechanical officer, and can do a great deal to bring the two sides together and smooth out the rough places. If the trainmaster can be persuaded to attend the meetings of the mechanical men, they can then discuss all the matters at issue, with the master mechanic there as a mediator to explain and suggest; in most cases they will find the foremen ready to meet them considerably more than half way. If the operating officials will visit the foremen themselves frequently, keep them in touch with the traffic conditions and with what their plans are for moving the business, get in touch with the conditions which surround the foremen and instruct their despatchers to use a little more judgment and tact in ordering power and asking for information, they will find that there will be much less friction and much more satisfactory relations all around. The master mechanic should be in a position to realize just what his foremen are up against and also the conditions under which the operating force is working. By the use of a little tact he can bring home to both sides the fact that they are working to the same end, and that if they work in harmony that end will be much easier to attain.



General Arrangement and Details of Lanz Superheater.

SUPERHEATER AND FEED WATER HEATER

Arthur T. Lanz, Winterthur, Switzerland, has designed a new type of high degree superheater and in conjunction with it has arranged a feed water heater which employs the same design of elements. In the superheater are three sets of two elements each on each side of the boiler, connected to vertical headers as shown in the illustration. Each of the elements consists of a hollow casting shaped like a horseshoe, in which the ends of three single loop heater pipes that extend back in the large boiler flues are expanded. The elements are arranged with the open space at the bottom, thus allowing brushes and tools to be inserted for cleaning the flues and the outside of the superheater pipes. The inventor states that since superheater surface is more efficient where the direction of flow of the steam and the hot gases is opposed, he has inserted thin twisted strips of metal in the return section of each of the loops to improve the efficiency of this part of the element and make all of its surface of equal value.



The feed water heater has four of the same design of elements connected in series in the feed pipe which enters at one side of the smokebox and continues to the check valve on the opposite side. The headers of these elements are located near the front end of the smokebox so as to employ the heat of the gases in the front end to some extent. There are no spiral strips of metal inserted in the return tubes of these elements. With the arrangement shown in the illustration it is necessary to provide a continuous feed from an injector or a pump. If the continuous feed is not possible a combination check valve having a connection to the lower part of the boiler and entering the feed pipe ahead of the first element, would have to be provided. This check valve would be arranged so that when the injector or pump was in operation it would be closed, but when there was no fresh feed water entering, the check would open and provide a circulation from the boiler through the elements, thus preventing them from being overheated. Dampers are provided for the superheater, but not for the feedwater heater. It will be noted that plugs are provided opposite both ends of each of the pipes in the elements allowing the interior of these pipes to be easily and thoroughly cleaned.

ITALIAN RAILWAY EARNINGS.—The Italian state railways (pretty nearly the whole system of the kingdom) earned gross in the fiscal year ended June 30, 1912, an average of $7,667 per mile, which is $474, or more than 6½ per cent., more than in the previous year. The aggregate increase was $6,428,000.

AVIATION RECORD.—An aviator, Faller, at Berlin, Germany, on January 4, remained in the air for more than an hour, with five passengers; and on January 5, he ascended with seven passengers and remained up seven minutes. The seven passengers, with the aviator, weighed 1,242 lbs.

A TABULAR COMPARISON OF RECENT SIMPLE FREIGHT LOCOMOTIVES

ARRANGED IN ORDER OF TOTAL WEIGHTS IN EACH TYPE

Type	SANTA FE (2-10-2)		MIKADO (2-8-2)														CONSOLIDATION (2-8-0)	
Name of road	C.B.&Q.	A.T.&S.F.	Erie	C.R.I.&P.	C.&O.	D.L.&W.	C.B.&Q.	G. N.	C.I.&L.	I. C.	M. P.	B. & O.	B. R. & P.	Southern	C. & A.	O. R. & N.	P. R. R.	P. Mar.
Road number or class	6000	1693	3001	R-57	800	1211	O 2	3000	504	1621	1241	Q 1	400	4506	808	440	H. 8 B.	901
Builder	Baldwin	Baldwin	Baldwin	Amer.	Amer.	Amer.	Baldwin	Baldwin	Amer.	Baldwin	Amer.	Baldwin	Amer.	Baldwin	Amer.	Baldwin	R. R. Co.	Amer.
When built	1912	1912	1912	1912	1912	1912	1912	1911	1912	1911	1911	1911	1912	1911	1910	1910	1909	1912
Tractive effort, lbs	71,500	63,580	57,460	57,100	60,800	57,000	60,000	57,500	53,900	51,700	50,000	50,200	51,133	51,700	48,300	45,300	42,661	50,328
Weight, total, lbs	378,700	295,900	320,600	318,850	315,000	312,000	303,400	287,000	285,000	283,850	275,000	274,600	273,500	272,940	269,000	263,100	238,300	229,000
Weight on drivers, lbs	301,800	248,900	237,150	243,200	243,000	236,500	231,000	220,000	213,500	218,300	209,500	219,000	216,500	215,700	212,300	204,450	211,000	206,000
Weight on truck, lbs	26,600	21,400	29,600	25,500	27,000	27,500	29,400	27,000	27,500	25,050	27,000	19,500	22,500	22,860	24,000	24,100	27,300	23,000
Weight on trailer, lbs	50,300	25,600	53,850	50,150	45,000	48,000	43,000	40,000	44,000	40,500	38,500	36,100	34,500	34,380	32,700	34,550	.....	.....
Weight of tender, loaded, lbs	183,300	173,900	162,400	161,150	169,700	159,700	176,600	148,000	162,200	171,150	156,100	175,400	170,000	147,060	168,700	161,900	158,000	153,400
Wheel base, driving, ft. & in	20—9	19—9	16—6	17—0	16—6	17—0	16—9	16—9	17—0	16—6	11—6	16—9	16—6	16—6	16—6	16—0	17—½	17—6
Wheel base, total engine, ft. & in	39—8	35—10	35—0	35—2	34—10	35—5	35—9	35—0	34—9	35—2	34—9	35—0	34—9	34—9	34—9	34—8	25—9½	26—5
Wheel base, engine and tender, ft. & in	74—4¼	66—4	66—10½	67—2½	67—11	67—7	67—¾	68—2	68—0	65—1⅜	67—0	71—2⅝	67—4¾	67—¾	67—½	64—7	59—5⅜	59—6½
Diameter of drivers, in	60	57	63	63	56	63	64	63	63	63	63	64	63	63	62	57	62	57
Cylinders, diameter, in	30	28	28	28	29	28	28	28	28	27	27	24	26½	27	28	23¾	24	25
Cylinders, stroke, in	32	32	32	30	28	30	32	32	30	30	30	32	30	30	30	30	28	30
Valve gear, type	Wals.	Wals.	Baker	Baker	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.
Steam pressure, lbs	175	170	170	180	170	180	180	170	170	175	170	205	180	175	160	180	205	180
Boiler, type	Str.	W. T.	Conical	Str.	Conical	Str.	Str.	Belpaire	E. W. T.	Str.	Conical	E. W. T.	E. W. T.	W. T.	Conical	Str.	Belpaire	Str.
Boiler, smallest diameter, in	88½	80¾	84	86	83¾	88	88½	82	80	82	75¾	78	74	76	76	82	76¾	81⅝
Tubes, number and diameter in inches	285—2¼	251—2¼	232—2¼	238—2¼	238—2¼	304—2	275—2¼	326—2	258—2	262—2	224—2	389—2¼	240—2	183—2¼	239—2	495—2	465—2	216—2¼
Flues, number and diameter in inches	30—6	36—5½	36—5½	36—5½	40—5½	43—5⅜	30—6	30—5½	34—5⅜	36—5⅜	30—5⅜	.....	32—5⅜	30—5½	30—5¼	.....	.....	34—5¼
Length of tubes and flues, ft. & in	22—7½	21—0	21—0	21—0	19—0	21—0	21—0	21—0	20—2	20—6	16—6	21—0	20—0	20—0	20—2	20—6	15—0	15—½
Heating surface, tubes & flues, sq. ft	4,841	4,174	3,936	4,004	3,740	4,592.8	4,373	4,471	3,671	3,833	2,614	4,789	3,395	3,007	3,312	5,292	3,652	2,655
Heating surface, firebox, sq. ft.*	320	193	219	260	311.2	261.3	254	249	245.5	235	254	228	240	191	194.5	267	187	185
Heating surface, total, sq. ft	5,161	4,367	4,155	4,264	4,051.2	4,859.1	4,627	4,720	3,916.5	4,068	2,868	5,017	3,635	3,198	3,506.5	5,559	3,839	2,840
Heating surface, superheater, sq. ft	970	910	1,050	848	845	1,065	961	1,060	812	1,093	558	.....	757	837	702	.....	.....	.....
Grate area, sq. ft	88	58.5	70	63	66.7	63.1	78	78.2	54.5	70	49.5	70	56.5	58.3	49.5	70	55.13	56.5
Firebox, length, in	139	108	120	108	114	108	117	117	107⅞	120⅝	108⅛	120	108	107⅛	108	120	110¼	108
Firebox, width, in	96	78	84	84	84	84¼	96	96	73¼	84	66	84	75¼	71¾	66	84	72	75¼
Kind of fuel	Bit. coal	Oil	Bit. coal	Bit. coal	Bit coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Lignite	Bit. coal	Bit. coal
Tender, coal capacity, tons	15	3,300 g.	16	16	15	14	14	13	15	15	14	16	14	14	14	10	17.5	14
Tender, water capacity, gals	10,000	9,000	9,000	9,000	9,000	8,000	9,200	8,000	8,500	9,000	8,000	9,500	9,000	8,000	8,500	9,000	7,000	8,000
Weight on drivers ÷ tractive effort	4.22	3.92	4.11	4.26	4.00	4.15	3.85	4.98	3.97	4.23	4.18	4.37	4.23	4.17	4.38	4.50	4.95	4.09
Weight on drivers ÷ total weight, per cent.	79.90	84.00	74.00	76.50	77.10	75.90	76.10	76.50	75.00	77.10	76.30	80.00	79.20	79.00	78.80	77.80	88.50	90.00
Evap. heat. surf. ÷ superheater heat. surf.	5.31	4.80	3.95	5.04	4.80	4.56	4.81	4.45	4.81	3.72	5.15	.....	4.80	3.82	5.00	.....	.....	.....
Firebox heat. surf. ÷ total heat. surf., per ct.	6.20	4.42	5.25	6.10	7.67	5.38	5.50	5.28	6.29	5.80	8.85	4.56	6.60	6.00	5.53	4.80	4.88	6.52
Firebox heat. surf. ÷ grate area	3.64	3.30	3.13	4.12	4.70	4.15	3.26	3.19	4.50	3.35	5.12	3.26	4.24	3.28	3.93	3.80	3.38	3.28
Total heat. surf. ÷ grate area	58.60	74.50	59.30	67.70	60.80	77.20	59.30	60.30	71.70	58.10	57.90	71.80	64.20	54.70	70.90	79.20	69.20	50.20
Tractive effort × diam. drivers ÷ heat. surf.	832.00	830.00	870.00	843.00	840.00	739.00	809.00	770.00	865.00	800.00	1,100.00	640.00	888.00	1,019.00	854.00	465.00	690.00	1,015.00
Total weight ÷ total heat. surf	73.30	68.00	77.00	74.80	77.80	64.20	65.50	60.80	72.80	69.80	95.20	54.80	75.20	85.40	76.50	47.40	62.10	80.70
Volume of cylinders, cu. ft	26.18	22.70	22.78	21.40	21.40	21.40	22.70	22.70	21.40	20.00	19.86	16.80	19.20	19.86	21.40	16.00	14.62	17.04
Total heat. surf. ÷ cylinder volume	197.00	192.00	183.00	199.00	189.00	227.00	204.00	209.00	183.00	203.00	144.00	300.00	189.00	161.00	164.00	360.00	262.00	167.00
Grate area ÷ cylinder volume	3.36	2.58	3.08	2.94	3.12	2.94	3.44	3.45	2.54	3.5	2.48	4.17	2.96	2.93	2.31	4.53	3.76	3.32
Reference for photograph, elevation or description	Am.Engr. 1912-p231	Am.Engr. 1912-p515	Am.Engr. 1912-p87	Am.Engr. 1912-p563	Am.Engr. 1912-p128	Am.Engr. 1912-p459	Am.Engr. 1912-p619	Am.Engr. 1911-p424	Loc. Dic. 1912-p174	Am.Engr. 1911-p346	Am.Engr. 1911-p437	Am.Engr. 1911-p141	Am.Engr. 1912-p251	Am.Engr. 1911-p476	.....	Am.Engr. 1910-p404	Am.Engr. 1910-p69	Loc. Dic. 1912-p173

*Includes surface of arch tubes and of combustion chamber where used.

TABULAR COMPARISON OF TYPICAL LOCOMOTIVES OF THE MALLET ARTICULATED TYPE

ARRANGED IN ORDER OF TOTAL WEIGHTS IN EACH TYPE

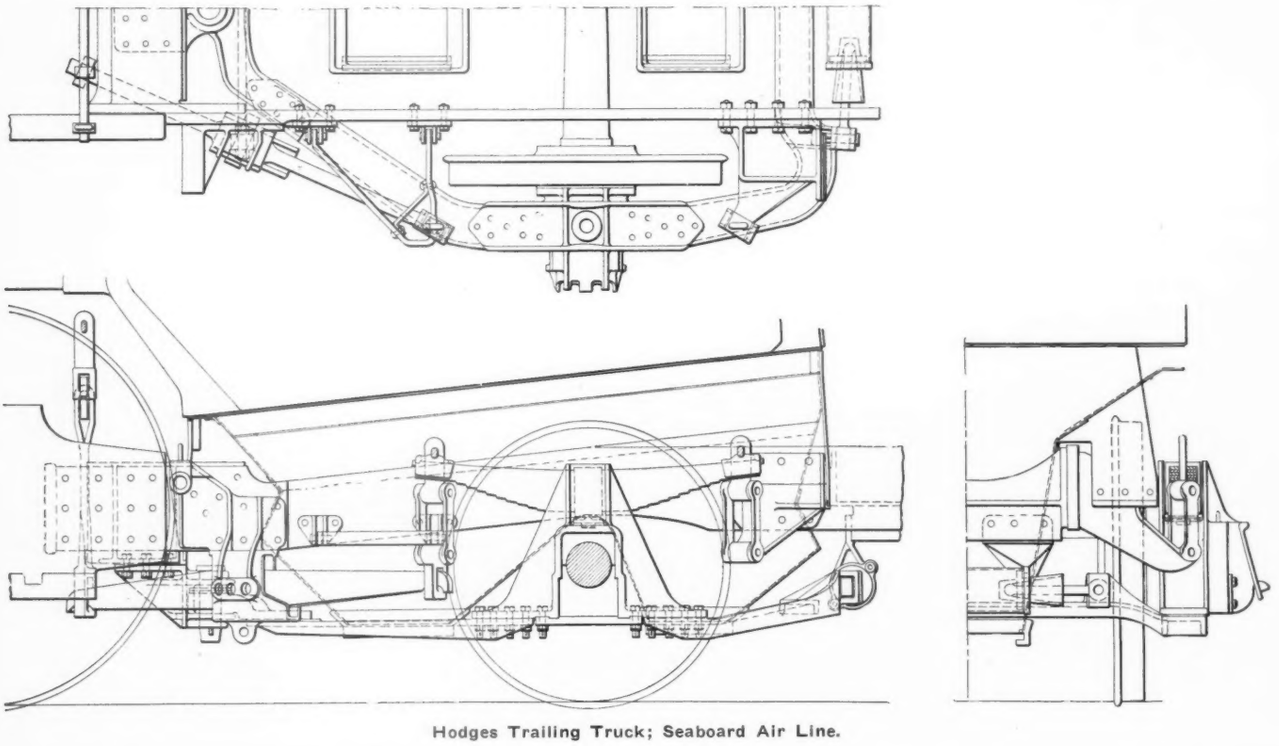
Type	2-10-10-2	2-8-8-2	2-8-8-2	0-8-8-0	0-8-8-0	2-8-8-0	2-8-8-2	2-8-8-2	2-8-8-2	2-8-8-2	2-6-6-2	2-6-6-2	2-6-6-2	2-8-8-2	2-6-6-2	2-6-6-2	0-6-6-0	0-6-6-0
Name of road	Santa Fe	Virginian.	P. R. R.	B. & O.	D. & H.	G. N.	D.M.&N.	Iron M.	So. Pac.	St.L.&S.F.	C. & O.	C.M.&P.S.	Santa Fe	N. & W.	C. C. & O.	N. Y. C.	K. C. S.	Can Pac.
Road number or class	3000	604	3396	2401	1608	2009	206	4000	4022	2007	763	5026	1158	999	M-2	1375	710	.....
Builder	R. R. Co.	Amer.	Amer.	Amer.	Amer.	Baldwin	Baldwin	Baldwin	Baldwin	Amer.	Amer.	Amer.	Baldwin	Baldwin	Baldwin	Amer.	Amer,	R. R. Co.
When built	1911	1912	1912	1911	1911	1912	.....	1912	1912	1911	.....	1912	1911	1910	.....	1911	.....	1911
Tractive effort, lbs	111,600	115,000	99,200	105,000	105,500	100,000	91,000	94,500	85,400	83,300	72,800	75,000	61,500	77,000	77,600	67,500	81,900	57,500
Weight, total, lbs	616,000	540,000	483,000	468,500	457,000	450,000	448,100	435,000	432,600	418,000	400,000	396,000	392,300	390,000	378,650	354,000	352,000	262,000
Weight on drivers, lbs	550,000	479,200	435,500	468,500	457,000	420,000	406,600	395,000	398,500	360,000	337,500	327,500	317,300	360,000	325,850	301,500	352,000	262,000
Weight on truck, lbs	.....	.....	23,500	.....	.....	30,000	19,100	20,000	16,100	25,500	23,500	21,000	29,000	15,000	24,600	26,000	.....	.....
Weight on trailer, lbs	.....	.....	24,000	.....	.....	.....	22,400	20,000	18,000	32,500	39,000	47,500	46,000	15,000	28,200	26,500	.....	.....
Weight of tender, loaded	234,000	212,000	186,400	181,500	168,800	150,000	171,900	155,000	179,400	149,600	163,200	166,900	169,700	170,000	171,350	153,700	174,000	133,00
Wheel base, driving, ft. & in	19—9	15—6	15—6	15—0	14—9	16—6	15—0	15—0	15—0	15—6	10—0	10—0	37—10	40—3	10—8	30—8½	10—2	10—4
Wheel base, total engine, ft. & in	66—5	57—4	57—5	40—8	40—2	52—6	58—2	56—7	56—7	56—8	48—10	48—0	56—5	55—6	46—6	46—9	31—2	35—2
Wheel base, engine and tender, gt. & in	108—1⅝	.....	88—½	77—2¾	75—7½	83—1	87—6	85—2¼	90—4	85—6¼	80—9¼	79—8¼	89—3	83—3	74—11	75—8	70—8¾	60—9½
Diameter of drivers, in	57	56	56	56	51	63	57	55	57	57	56	57	69	56	57	57	56	58
Cylinders, number	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Cylinders, diameter, in	28 & 38	28 & 44	27	26 & 41	26 & 41	28 & 42	26 & 40	26 & 40	26 & 40	24½ & 39	22 & 35	23½ & 37	24 & 38	24½ & 39	24 & 37	21½ & 34	22 & 35	20
Cylinders, stroke, in	32	32	28	32	28	32	32	32	30	30	32	30	28	30	32	32	32	26
Valve gear, type	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.	Wals.
Steam pressure, lbs	225	200	160	210	220	210	200	200	200	200	200	200	220	200	200	200	225	200
Boiler, type	E. W. T.	W. T.	Conical	Conical	Conical	Belpaire	Str.	Str.	Str.	Conical	Conical	Conical	Str.	Str.	Str.	Str.	Str.	E. W. T.
Boiler, smallest diameter, in	79	101¼	86	89⅞	90	90	84	84	84	81⅝	83⅜	83¾	70	80	86	86¾	86	18–2, 167–2¼
Tubes, number and diameter	377—2¼	334—2¼	282—2¼	277—2¼	270—2¼	332—2¼	401—2¼	260—2¼	401—2¼	342—2¼	244—2¼	225—2¼	294—2¼	350—2¼	448—2¼	235—2¼	250—2¼	22—5¼
Flues, number and diameter	.....	48—5½	45—5½	38—5½	42—5½	42—5½	.....	36—5½	.....	.....	36—5½	38—5½	.....	.....	.....	36—5½	36—5½	22—5¼
Length of tubes and flues, ft. & in	16—5	24—0	24—10	24—0	24—0	24—0	21—0	21—0	21—0	24—0	24—0	24—0	19—7	21—0	21—0	22—0	21—0	20—0⅜
Heating surface, tubes & flues, sq. ft	3,625.0	6,350	5,701	5,205.5	5,245	6,120	4,939	4,281	4,941	4,817.1	4,674	4,898	3,376	4,309	5,519	4,168	4,160	2,765
Heating surface, firebox, sq. ft	294.5	410	424	321.4	353	326	255	252	232	344.7	390	342	234	210	233	225	214	185
Heating surface, total, sq. ft	6,579*	6,760	6,125	5,526.9	5,598	6,446	6,833*	5,763*	6,393*	5,161.8	5,064	5,240	5,403*	5.908*	5,752	4,393	4,373	2,949
Heating surface, superheater, sq. ft	2,328†	1,310	1,257	1,002.0	1,106	1,368	160‡	890	623‡	.....	911	1,068	390†§	586‡	.....	966.3	858	548
Grate area, sq. ft	81.9	99.2	96.5	99.9	100	78.4	84	84	68.4	75.4	72.2	72.3	52.5	75.2	78	56.5	72.3	59
Firebox, length, in	149⅝	174	144⅛	126⅞	126	117¼	126⅛	126	126	120⅛	108⅛	108⅛	119⅝	120⅛	117	108⅛	108⅛	120
Firebox, width, in	78¾	109	96¼	114	114	96¼	96	96	78¼	90¼	96⅛	96¼	63¼	90¼	96	75¼	96¼	70⅞
Kind of fuel	Oil	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Oil	Bit. coal	Bit. coal	Bit. coal	Bit coal	Bit. coal	Bit. coal	Bit. coal	Oil	Bit. coal
Tender, coal capacity, tons	4,000 g.	15	15	16	14	13	16	14	3,200 g.	10	15	14	12	14	15	12	3,500 g.	12
Tender, water capacity, gals	12,000	12,000	9,000	9,500	9,000	8,000	9,000	8,000	10,000	8,000	9,000	9,000	9,000	9,000	10,000	8,000	9,000	5,900
Weight on drivers ÷ tractive effort	4.95	4.16	4.39	4.68	4.33	4.20	4.46	4.17	4.67	4.32	4.72	4.37	5.16	5.15	4.20	4.47	4.30	4.55
Weight on drivers ÷ total weight, per cent.	89.50	88.50	92.00	100.00	100.00	93.50	90.30	91.00	92.50	86.00	84.25	82.50	80.90	92.00	86.00	85.20	100.00	100.00
Evap. heat. surf. ÷ superheater heat. surf.	2.82	5.16	4.87	5.52	5.00	4.70	.....	6.47	.....	.....	5.55	4.91	13.85	.....	.....	4.55	5.10	5.39
Firebox heat. surf. ÷ total heat. surf., per ct.	4.47	6.07	6.80	5.80	6.32	5.07	3.70	4.37	3.63	6.69	7.70	6.55	4.32	3.56	4.06	5.13	4.90	6.28
Firebox heat. surf. ÷ grate area	3.58	4.10	4.25	3.22	3.53	4.16	3.04	3.00	3.38	4.56	3.48	4.74	4.46	2.79	2.98	3.98	2.96	3.14
Total heat. surf. ÷ grate area	80.50	68.20	64.50	55.10	55.98	82.10	81.80	68.70	93.30	68.45	70.00	72.70	103.00	78.50	73.80	77.80	60.40	64.00
Tractive effort × diam. drivers ÷ heat. surf.	970.00	954.00	907.00	1,061.00	961.00	975.00	751.00	903.00	762.00	919.85	804.00	813.00	786.00	730.00	767.00	873.00	1,049.00	884.00
Total weight ÷ total heat. surf	93.90	80.00	78.60	84.60	81.70	69.80	65.00	75.70	67.70	80.97	79.10	75.50	72.50	65.90	65.90	80.70	80.40	69.50
Volume equivalent simple cylinders, cu. ft.	30.10	34.44	37.08	29.95	26.00	32.20	29.30	29.30	28.64	25.50	21.80	22.80	20.60	25.50	23.60	20.60	21.80	19.00
Total heat. surf. ÷ cylinder volume	218.00	195.6	165.0	185.50	215.00	200.00	234.00	196.20	221.00	202.42	232.00	229.00	262.00	231.50	243.00	213.00	201.00	198.00
Grate area ÷ cylinder volume	2.72	2.88	2.68	3.33	3.85	2.44	2.86	2.87	2.37	2.95	3.31	3.17	2.54	2.07	3.31	2.74	3.30	3.10
Reference for photograph, drawings or description	Am.Engr. 1911-p171	Am.Engr. 1912-p287	Am.Engr. 1912-p150	Am.Engr. 1911-p182	Loc. Dic. 1912-p188	Am.Engr. 1912-p587	Loc. Dic. 1912-p191	Am. Engr. 1912-p420	Loc. Dic. 1912-p191	Am. Engr. 1911-p50	Loc. Dic. 1912-p191	Loc. Dic. 1912-p189	Am.Engr. 1911-p102	Am.Engr. 1910-p269	Loc. Dic. 1912-p189	Loc. Dic. 1912-p189	Loc. Dic. 1912-p186	Loc. Dic. 1912-p347

*The feed water heater surface is included. †Buck-Jacobs low degree superheater. ‡Reheater surface. §Also has a reheater of 719 sq. ft. surface.

NEW DESIGN OF TRAILER TRUCK

A new design of Hodges trailing truck has been applied to 20 Pacific type locomotives built for the Seaboard Air Line by the Baldwin Locomotive Works. Five of these locomotives have 71 in. drivers and are intended for passenger service, while 15 have 63 in. drivers and are to be used in freight service. They have 23 in. x 28 in. cylinders, carry 185 lbs. steam pressure and are equipped with superheaters, outside steam pipes and Baker valve gear. The boilers are of the wagon top type, 71 in. in diameter at the front end and have 199 two-inch tubes, 19 ft. long, and twenty-four 5⅜ in. flues. The firebox has a heating surface of 208 sq. ft., and is provided with a brick arch. The total heating surface is 2,818 sq. ft., and the grate area is 53.1 sq. ft. The passenger locomotives have a weight of 133,900 lbs. on drivers and a total weight of 211,600 lbs. The weight on the trailer is 37,600 lbs. The freight locomotives weigh 139,150 lbs. on drivers and 218,350 lbs. total. The weight on the trailer is 36,200 lbs.

The Hodges trailing truck, as heretofore built, has jointed spring hangers arranged to swing in a plane perpendicular to the center line of the locomotive and connected at their lower ends to the ends of two cross beams, the one at the rear being secured to the frames. The main equalizers from the rear driving springs extend backward parallel with the frames and rest on the forward cross beam. In the new design the cross beams have been dispensed with and the main equalizer is placed in a diagonal position connecting directly to the bottom of the front spring hanger of the trailer truck. At its forward end it rests on a hanger supported by a cross beam connecting the rear spring hangers of the driving springs. The rear spring hanger of the trailer truck is carried from a bracket bolted to the frame. Both trailer truck spring hangers are made up of links arranged to swing in a plane tangential to arcs struck from the radius bar pin as a center. The trailer truck frame has a spring centering device arranged as shown in the illustration, which does not differ materially from the previous arrangement. With this new design of truck it will be seen that the absence of the cross beams permits the better arrangement of the ash pan and its operating gear, reduces the weight somewhat and also will probably overcome any tendency for the trailer truck springs to get out of alinement with the truck frame when the locomotive is curving. It will be noticed that a guide is provided to insure the correct position of the front spring hanger. This is hinged to the frame and allows free vertical movement.

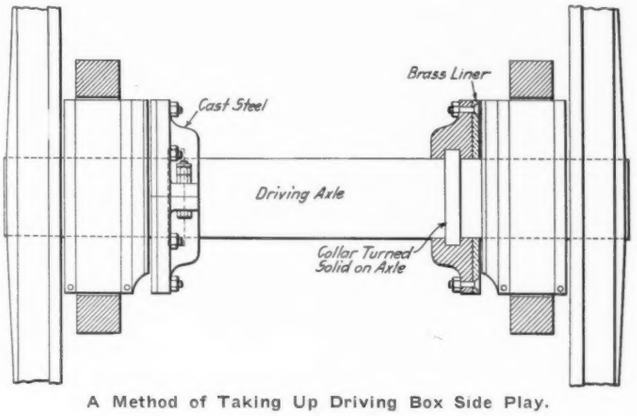


Hodges Trailing Truck; Seaboard Air Line.

TAKING UP LATERAL PLAY

BY JAMES STEVENSON,
Gang Foreman, Pennsylvania Railroad, Olean, N. Y.

The method shown in the drawing, of taking up side play in driving boxes, requires the use of a cast steel collar which is clamped over a collar forged on the axle. The wear is taken by a brass liner which is attached to the face of the cast steel collar by bolts with countersunk heads. This device has not as yet been tried out in practice.



A Method of Taking Up Driving Box Side Play.

Ore Shipments on the Great Lakes.—The total movement of ore on the Great Lakes for 1912 was 47,435,777 tons, which is an increase of 15,305,366 tons over 1911.—*Iron Trade Review.*

SHOP PRACTICE

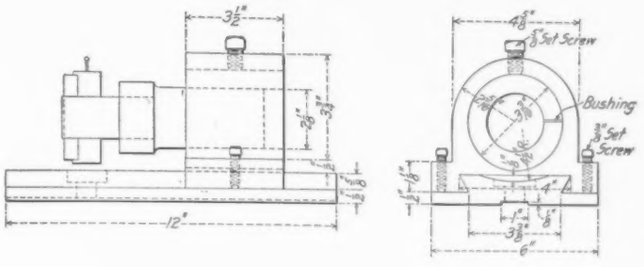
MACHINE SHOP KINKS

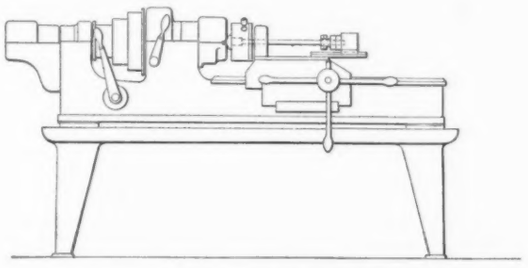
BY C. L. DICKERT,
Assistant Master Mechanic, Central of Georgia, Macon, Ga.

TURNING AND THREADING RADIAL STAYS.

A convenient and economical method of turning and threading radial stays is shown herewith. An ordinary turning tool is used for finishing under the head but the ends are turned by a special tool. This is made from a set of worn out dies. Three of them are ground flat and serve as guides while the fourth is ground for cutting. They are held in an automatic die head and perform the work satisfactory. Two sets of threading dies, located on opposite tool holders of a turret lathe, turn the thread on both ends of the stay at the same time.

The arrangement for holding the die chuck for the rear end of the stay is adjustable and slides freely on ways fastened to the turret. This die is started first, as it has the longer thread



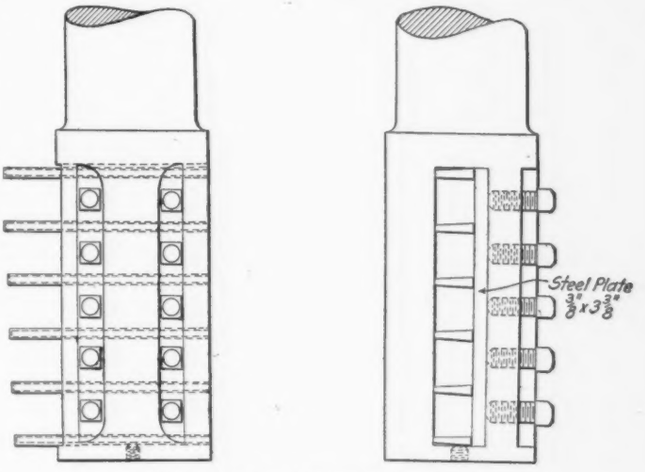


Arrangement for Turning and Threading Radial Stays.

to cut and the forward die is started so as to make them both finish at the same time. The forward die cuts up under the head, making a good fit in the boiler. Both dies are tripped automatically. The dies are adjusted so that the threads will carefully match with the boiler tap and the threads at the top and bottom of the bolt will also be sure to match with each other as the rear dies, being started first serves as a lead screw for the forward die. This device has materially increased the output and decreased the cost.

GANG TOOL FOR CUTTING PACKING RINGS.

The tool shown in the drawing is used for cutting cylinder packing rings. The holder is equipped with six cutting-off tools of tool steel, such as are used in the Armstrong cutting-off tool holders. Between these tools are filling blocks, machined to suit the taper of the tools and made to a thickness suitable for spacing the cutters to the width of the packing ring that is to be cut. On this road two width packing rings (¾ in. wide for light power and 1 in. for heavy power) are used, which require two sets of filling blocks. The filling blocks are made slightly narrower than the width of the tools to allow the steel plate to firmly clamp the cutting tools when the set screws are set up. A blind set screw is placed in the end of the tool holder merely to take up the slack in the tools and filling blocks, in order to maintain a uniform thickness of the rings. Each tool is set in the holder 1/16 in. in advance of the other, the top tool being the longer, so as to cause the first ring to be cut through first. This tool is fitted to a 52-in. Bull-



Gang Tool for Cutting Piston Rings.

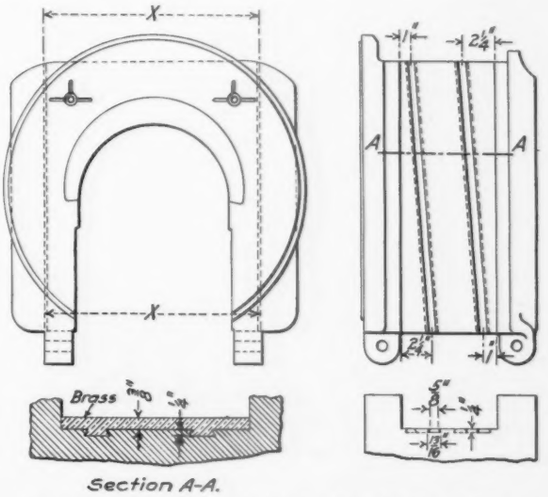
ard boring mill. Similar gang tools have been described in these columns, but they are somewhat different in detail.

DRIVING BOX KINKS

BY ALDEN B. LAWSON,
Draftsman, Baltimore & Ohio, Baltimore, Md.

BRASS LINERS FOR DRIVING BOX SHOE AND WEDGE FIT.

The illustration shows a method of applying brass liners to the shoe and wedge fits of driving boxes. In the case of old boxes, ⅜ in. is machined off each side, which reduces the dimen-



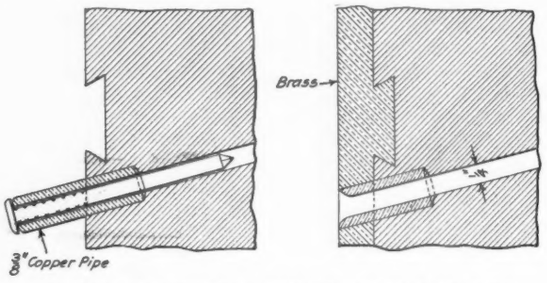
Brass Liner for Shoe and Wedge Fit of Driving Box.

sion *X*, the standard distance over the faces, by ¼ in. The dovetailed slots are planed at an angle to the flanges, as shown. For new boxes the width of the pattern is made ¾ in. less than the

standard dimension X, and the dovetailed slots are cast in. In both cases the brass is cast on the box and is finished to the standard dimension X. The slots at an angle with the flanges prevent the brass from falling off in case it becomes loose while being machined. When the liner has worn down to about ⅛ in. thick the brass is machined off, the slots are cleaned out and a new liner is cast on, which saves the driving box from being scrapped.

APPLYING OIL PIPE FOR DRIVING BOX HUB.

A method of applying a hub lubricating pipe to driving boxes which have brass hub liners cast on is shown in the drawing. A No. 20D. wire nail is inserted in a piece of ⅜ in. copper pipe, about 2 in. long, and the end is allowed to extend into the oil



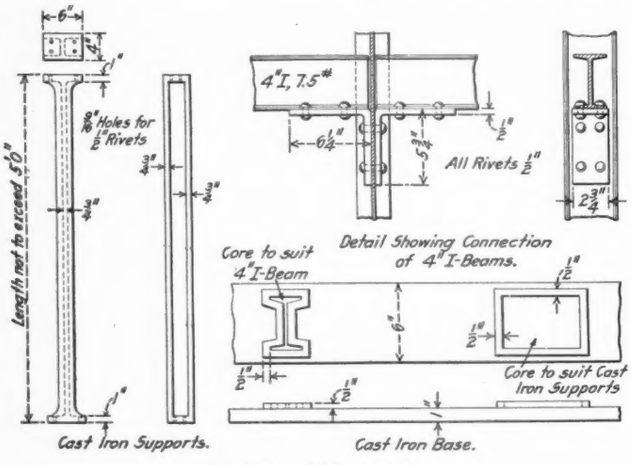
A Method of Applying a Driving Box Hub Oil Pipe.

hole, as shown. The pipe is then held in the proper position while the liner is being poured. After the hub liner is applied the nail is removed and the end of the pipe is cut off and chamfered, as shown in the illustration.

IRON RACK FOR SHORT LENGTHS

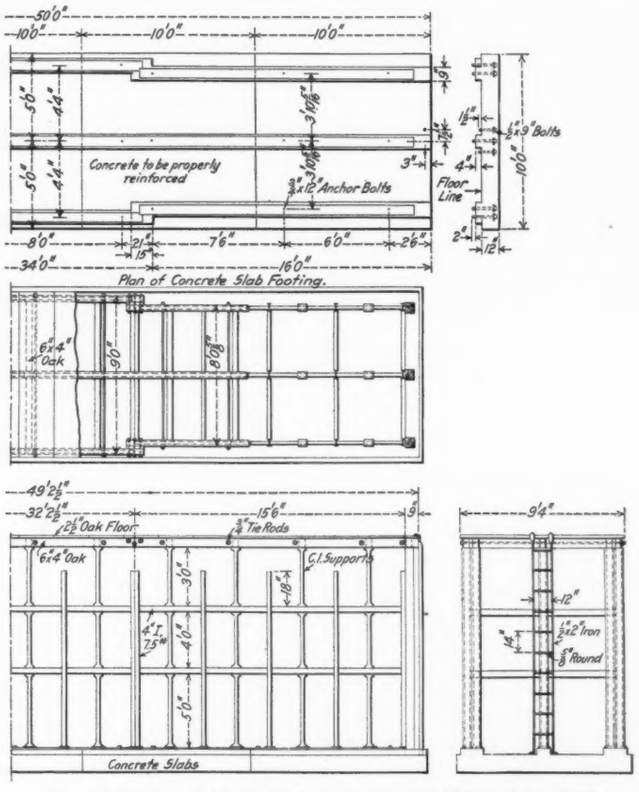
BY W. H. WOLFGANG,
Draftsman, Wheeling & Lake Erie, Toledo, Ohio.

The rack shown in the drawings was designed for storing material of less than 10 ft. in length. Concrete slabs are used for the footing and they being only 10 ft. wide will permit of the rack being moved from place to place, if necessary. Where this is done, however, proper eyebolts should be anchored in the con-



Details of Iron Rack.

crete slabs for the crane chain hooks. Cast iron plates, 1 in. thick, are made in convenient lengths and bolted to the concrete slabs to prevent the abrasion of the concrete. They are cored out as illustrated for the cast iron supports and for the 4 in. I-beams so that they cannot move out of place. The cast iron supports can be either bolted or riveted to the I-beams, and the length of the support can be made to suit conditions. A 2½ in. oak floor is laid on top of the rack for the storage of all material too short to be placed in the bins. Iron ladders are secured to each end so that a man can easily climb to the top of the rack. The rack would be more convenient if located under a



Iron Rack for Storing Material of Less Than Ten Feet in Length.

traveling crane so the material could be more easily handled. The reason one end of the rack is narrower than the other is because the narrow part was an old rack which has been bolted to the new part.

REPLACING A DRIVER SPRING ON A MALLET

BY J. D. ROGERS,
Inspector, Virginian Railway

While the writer was in charge of some heavy Mallets at a pusher grade on the Virginian, it became necessary to change an intermediate driving spring on the front engine of one of them. The spring had 14 leaves ⅜ in. thick, and was 36 in. long. No jacks or spring pullers were available, and to have sent the engine to the nearest roundhouse would have held it out of service probably 48 hours or more. A 33 ft. rail on the spark track was removed and a 30 ft. rail substituted, filling out with a 3 ft. section held with fish plates. The spring rigging was blocked as high as possible by running the engine on a wedge; the 3 ft. section was removed between the main and intermediate wheels, and the intermediate wheel was run over the opening, allowing the box to drop down to the binder. The gibs were easily removed and the spring replaced. A wedge was then placed in the opening and the driver was returned to the rail. The total time occupied, including that of removing the rail, was about three hours.

Railway Employees in Switzerland.—The Swiss railways employ a total of 42,000 men, 35,200 of whom work on the state lines and 6,800 on private roads.

THE BULLDOZER IN RAILWAY SHOPS

Typical Examples of Two-Piece Dies Which Have Been Used Successfully on This Type of Machine.

BY LEWIS D. FREEMAN,
Chief Draftsman, Kansas City Southern, Pittsburg, Kan.

The bulldozer has contributed very greatly toward the present high efficiency of the railway blacksmith shop and is now used in nearly every large shop of this kind and in many steel car plants. While it was primarily designed for the hot bending and shaping of heavy bar iron, it is also suitable for hot and cold punching and cold flanging up to the capacity of the tools used.

It is desired in this article to set forth some experiments recently made with this machine to determine just what can be accomplished with two-piece dies, which have to be used on the bulldozer, as will be explained later. Fig. 1 shows a No. 9 bulldozer built by Williams, White & Co., Moline, Ill., the originators of this type of machine. This is one of the largest types and is driven by a 50 h. p., d. c. motor, mounted on a bracket on the side of the machine and geared direct to a reversing clutch shaft so that the machine can be run in either direction and reversed at will. On the clutch shaft is a heavy fly wheel which runs in the same direction as the motor; the energy stored in this fly wheel is sufficient to avoid any undesirable reduction

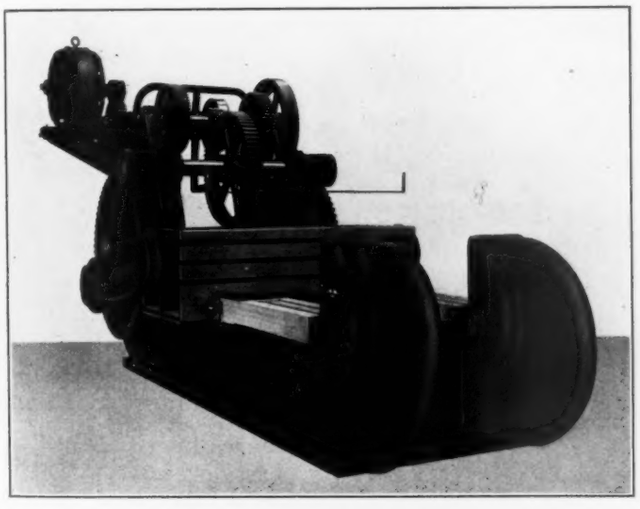


Fig. 1—Large Type of Bulldozer.

in the speed of the motor as the power required by the work fluctuates. The stroke of the machine is 24 in. and the die space is 49 in. from the forward position of the moving crosshead to the back stops or lugs.

When using small or medium size dies it is desirable to have a suitable surface plate or table across the ways of the machine, on which to set them. Such a table is shown in Fig. 2. It has a crosstie at the back to rest against the lugs and is provided with T-slots so that any die can be set on the surface plate, and squared up and bolted down in the most convenient position, saving the labor of placing odd packing back of the dies to bring them up to the moving crosshead. In this way the dies can be so designed that they will take up the entire die space and when they come together with the thickness of the metal between them, the proper pressure will be put on the shape under formation. The heavy set screws in the rear lugs are provided for the purpose of bringing the stationary die up to the moving one and to allow for variation in the material as well as for wear in the machine itself.

The power exerted by this machine is similar to that of the toggle joint. The nearer the crank pin approaches the forward dead center, the greater is the power exerted; but at the moment of approaching the dead center it is impossible to calculate the pressure exerted with any degree of accuracy. For this reason it is not desirable to place dies on the machine that are much higher than the rear lugs, even though the dies are tapered down to meet the top of the lugs. The center of gravity of the shape being formed determines the point of application of the reaction of these lugs; therefore the higher the shape in the dies the greater the stresses in the frame of the machine, which, while massive in construction, is not meant to resist excessive overloading. Many well designed formers are broken by carelessness,

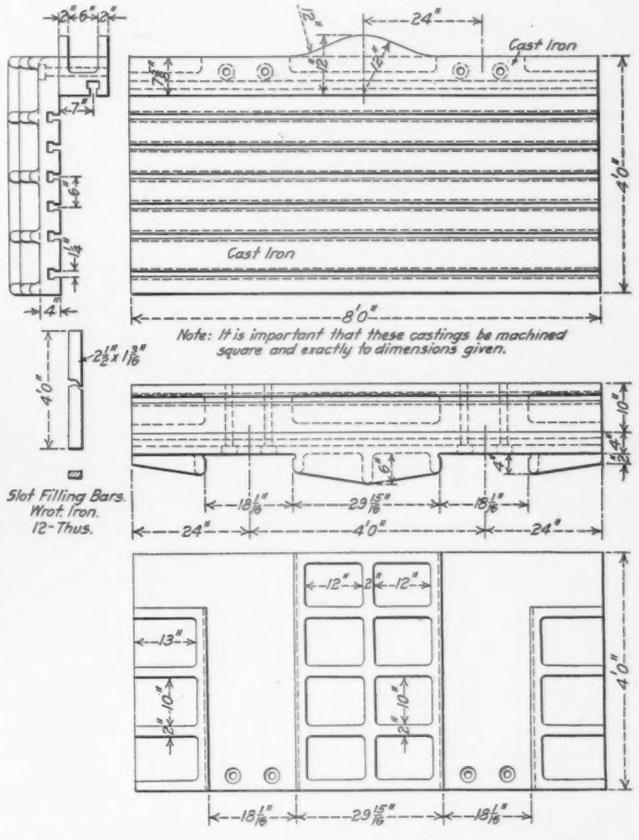


Fig. 2—Surface Plate for Holding Small Dies on a Bulldozer.

such as packing them too close to the moving crosshead, thus throwing great stresses on both the dies and the machine.

Since the force exerted by the crosshead at the moment the crank pin passes the dead center cannot be depended on, it is apparent that considerable skill and good judgment must be used in order to successfully design bulldozer dies. The question of strength in the design is largely a matter of experience, and once knowing how the machine acts with one set, it is safe to assume that all similar ones for the same machine may be built along the same lines. It is necessary to have the dies strong enough to withstand the total power of the machine, regardless of the power necessary to form the shape, as it is more convenient to let the crank make a full stroke so as to release the

work as quickly as possible. The backward motion of the machine is not available for power, and as parts attached to the

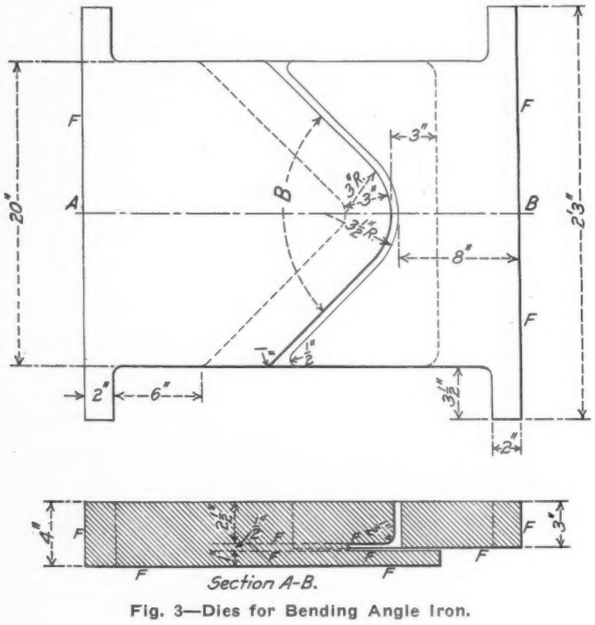


Fig. 3—Dies for Bending Angle Iron.

crosshead have to depend on the bolts for strength, only two piece dies can be used.

The illustrations show some examples of die practice now in successful use on this type of machine. Fig. 3 represents a simple

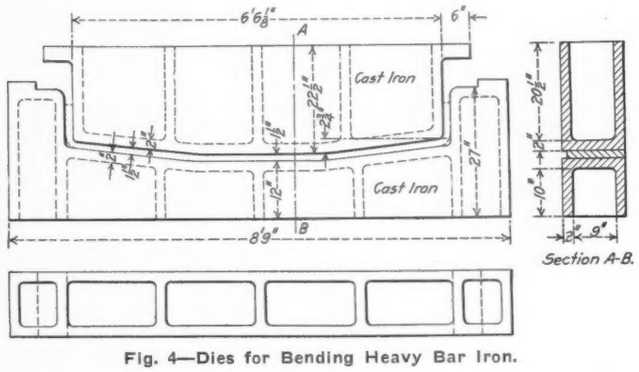


Fig. 4—Dies for Bending Heavy Bar Iron.

form for bending angle iron. It will be noted that there is a slot in the male die into which the lower flange of the angle is pressed. This slot is just wide enough to permit the flange to

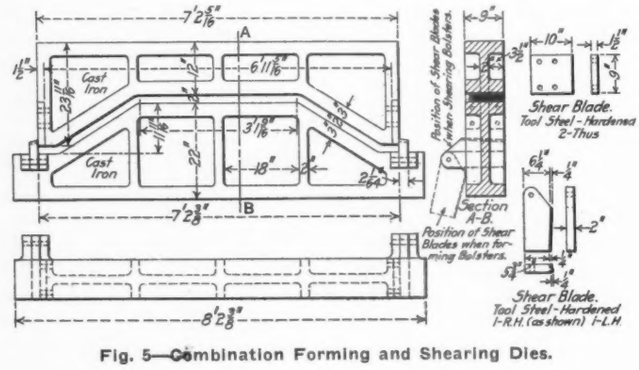


Fig. 5—Combination Forming and Shearing Dies.

enter, and keeps it free from buckling, while the vertical flange is forced to take the shape determined by the angle *B*.

The dies shown in Fig. 4 are a heavy type suitable for bending heavy bar iron, such as tender body bolster plates of 1½ in. x 12 in. section. The lugs on the face of the female die are for centering the plate before pressing, the shape of the die being exactly the same as that of the piece to be pressed, with the proper allowance for shrinkage. The coefficient of shrinkage for open hearth steel and boiler plate is .0078 and for merchant bar iron is .0156.

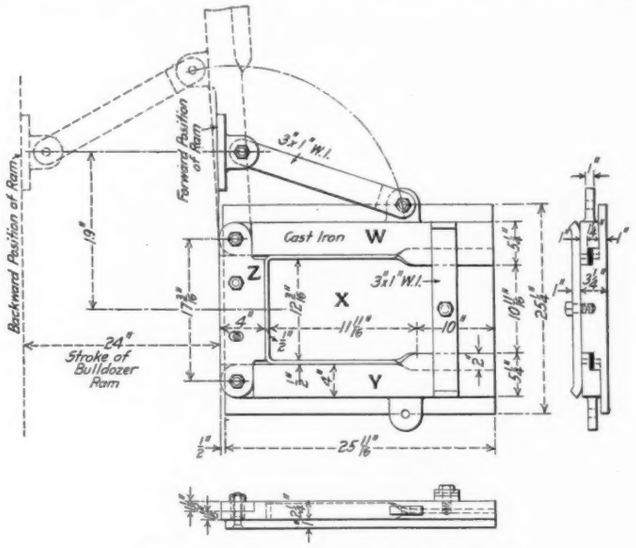


Fig. 6—Dies for Forming Freight Car Sill Steps.

In order to facilitate calculations, 1 plus the coefficient of shrinkage is used. Thus, for a 12 in. piece of thin open hearth steel plate, the calculation is 12 in. x 1.0078 equals 12.0836 in. or 12 3/32 in. nearly. Care should be taken to see that the proper coefficient is used.

Combination forming and shearing dies are shown in Fig. 5.

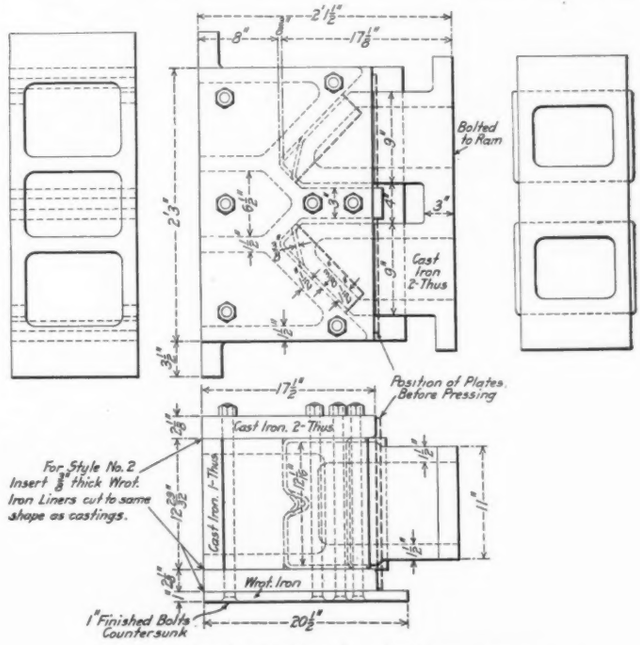

Bolted to Ram
Cast Iron 2-Thus
Position of Plates Before Pressing
Cast Iron. 2-Thus.
For Style No. 2 Insert ⅜" thick Wrot. Iron Liners cut to same shape as castings.
Cast Iron. 1-Thus
Wrot. Iron
1" Finished Bolts Countersunk

Fig. 7—Dies for Making Coupler Horn Braces.

These may be used for heavy bar iron and also truck arch bars which have not gib ends. By means of hinge joints on the top of the male die, the shear blades are thrown back out of the way while the forming is being done, and on the next stroke of the machine they are let down and the ends of the stock are cut off to the exact length required. The blades are made of tool steel and there are also tool steel faces on the female die. This

operation is one which makes a good showing for the bulldozer. The work was at one time done under a steam hammer and took five or six hours to complete, while it is now done on a bulldozer with two strokes of the machine, the actual time being less than one minute. In addition to the work being done quicker, there is the advantage of having all of the parts exact duplicates.

The safety appliance law makes it necessary to apply many

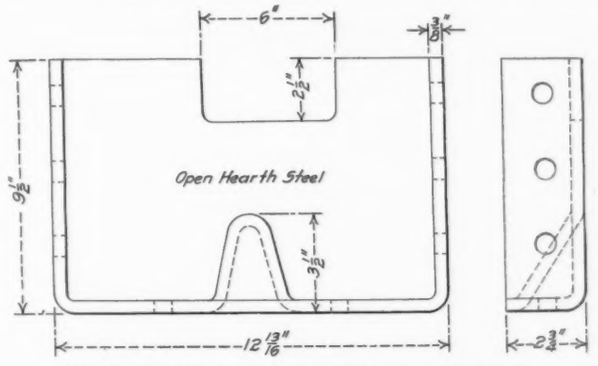


Fig. 8—Coupler Horn Brace Made on a Bulldozer.

new steps on old freight cars and Fig. 6 shows a wing type of die suitable for making them. These dies form the U shape of the step and also twist the ends at right angles for application to the car. The wings *W* and *Y* are operated by links attached to the crosshead of the machine in such a way that the crosshead can strike the slotted casting *Z* to prevent wrinkles forming on the tread of the step. The wrought iron tie bar across the ends of the wings is to overcome the reaction while the twisting

the bolts. Wherever possible it is better to make the dies solid, but in this case it was necessary to finish the inside to make the width of the braces the exact width to fit accurately between the center sills of the cars.

In making dies for heavy machinery, the castings should, if possible, be machined on their forming surfaces as well as on the faces resting against the machine, to insure an even distribution of the load when a part is being forged. This prevents damage to the dies, as well as to the machine. A great many good dies are broken by either improper fitting up or not being machined at all. It is essential that care be taken to properly design and finish the dies.

The two-piece dies shown in Fig. 9 are used for pressing diaphragms for steel car underframes. Several years ago a number of attempts were made to manufacture these on a bulldozer, but little success attended them. The design shown here was developed after a careful analysis of the other methods. To obtain a perfectly formed diaphragm it was formerly thought necessary to use a three-piece former, which can only be used on a hydraulic press of suitable size. The operation of this type has, however, been so successful that quite a number of similar ones are now under construction. In the operation of these dies, a blank sheet, properly sheared and heated to a bright red heat, is placed in front of the female die. The male die forces the sheet through the sizing section of the female die, the shape emerging into the recess shown by the dotted lines. At the end of the forward stroke, the sheet is forced against the back of the female die, which straightens out the back or web of the diaphragm. The flanges spread slightly and on the return stroke refuse to go through the sizing section of the die through which they previously came. The male die is then drawn back

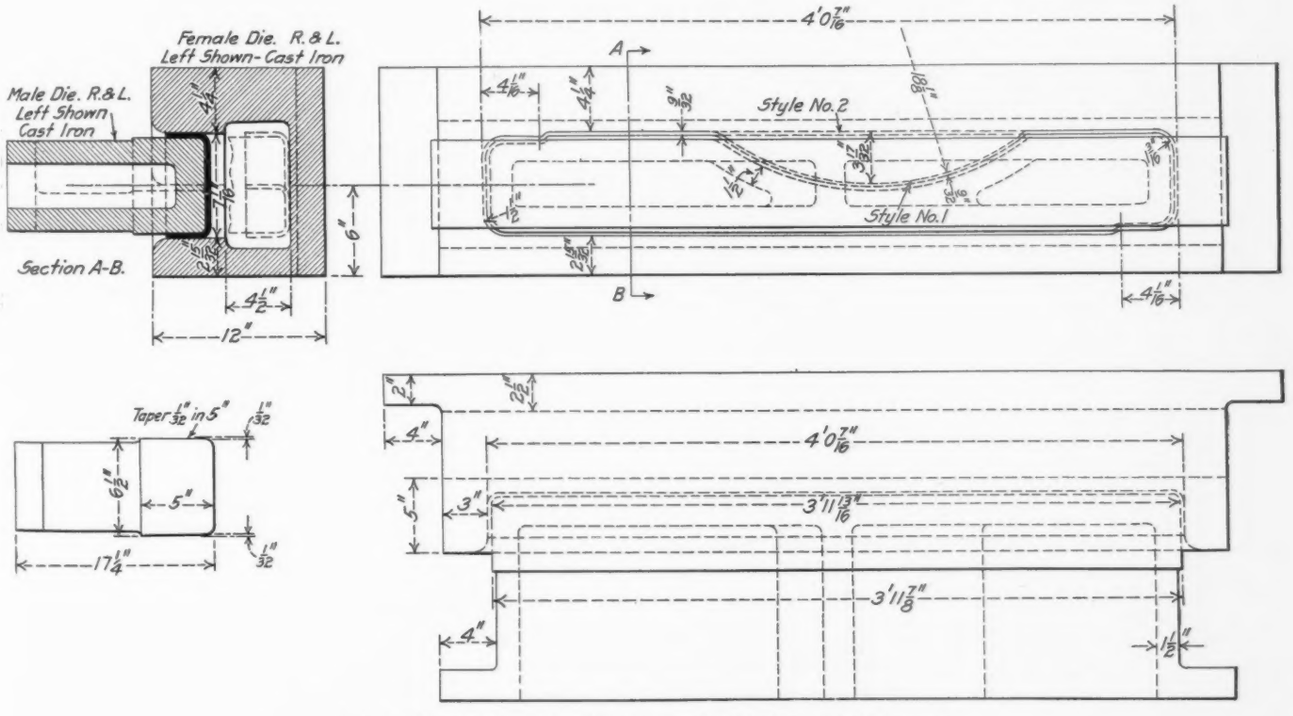


Fig. 9—Dies for Forming Diaphragms for Steel Car Underframes.

is being done and may be quickly displaced to remove the finished step.

Fig. 7 illustrates dies for making two coupler horn braces at one operation of the machine, the idea being to make one side take the reaction of the other. The completed forging is shown in Fig. 8. These dies are so constructed that two widths of the forging can be made by them. In general it is not good practice to make a built-up die for large work, as all the strain comes on by the crosshead, while the pressed shape is stripped off and remains in the recess of the female die, whence it may be pushed out completed through the opening in the end.

FUEL OIL IN AUSTRIA.—The increased price of fuel oil has affected the Austrian government, who will change their oil-burning locomotives back to coal burning.

APPRENTICE SCHOOLS ON THE ERIE

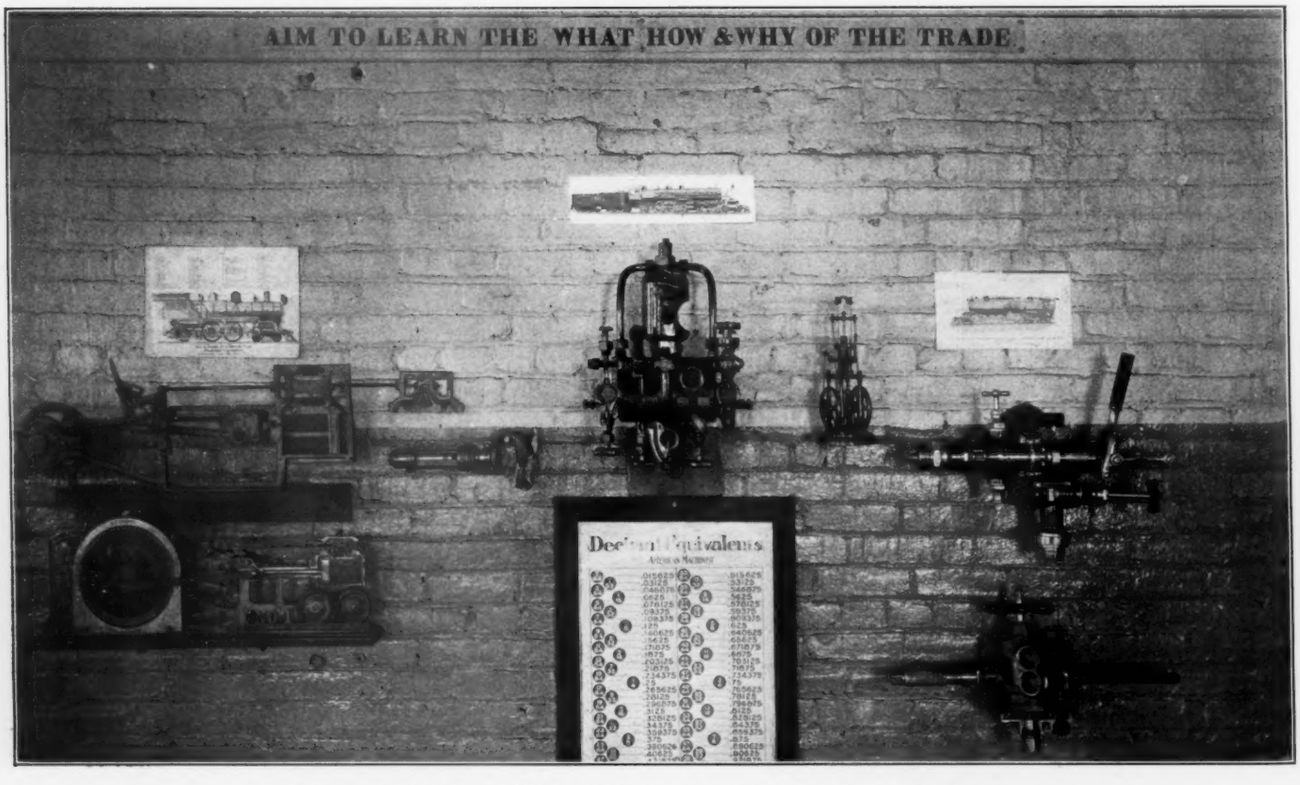
BY H. E. BLACKBURN,
Technical Instructor, Erie Railroad, Dunmore, Pa.

A system of apprentice schools was started on the Erie in 1908 and the road now has five schools on its lines. The boys chosen as apprentices are preferably employees' sons and must be over 17 and under 21 years of age. When they are selected they are given mental and physical examinations, and if acceptable are required to serve a three months' probationary period in the shop before they are finally accepted.

Each school is in session 40 weeks a year and the apprentices are required to attend two two-hour periods each week during the three years of their apprenticeship. The time is given to mechanical drawing, shop mathematics, and instruction in standard shop practice and it is the aim of the instructor to make the school as practical as possible. The instructor spends an average of about five hours daily in the shop with the boys.

No special efforts are made to turn out draftsmen or foremen, but if a boy shows an aptitude for any particular line of work he is sent to the main shop of the road and is given every opportunity to advance to the position towards which his ambition points. After a boy completes his apprenticeship, it is of course the aim to retain him in the company's employ, and every effort is made to do so.

Interior of the Erie Railroad Apprentice School at Dunmore, Pa.



Arrangement of Some of the Models in an Erie Railroad Apprentice School.

Patent Applications.—According to the report of the secretary of the interior for the year ended June 30, 1912, the U. S. patent office received during the year, 69,236 applications for mechanical patents, 1,775 for designs, 195 for reissues, 7,238 for trade marks, 941 for labels and 362 for prints. There were 35,539 patents granted, including reissues and designs.

SHOP KINKS

BY W. F. CANAVAN,
General Foreman, Missouri, Kansas & Texas, Parsons, Kansas.

TABLE FOR SLOTTING DRIVING BOX BRASSES.

A convenient method for clamping a driving box brass to a slotting machine so that it may be machined for the driving box

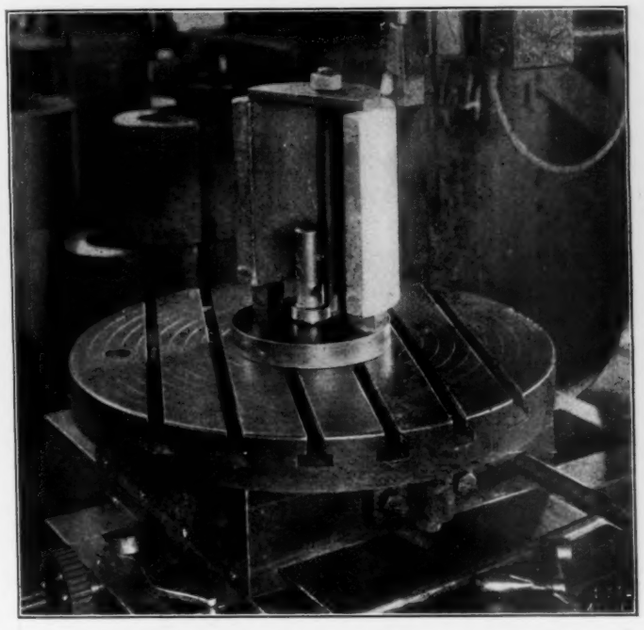


Fig. 1—Attachment for Slotting Driving Box Brasses.

fit is shown in Fig. 1. The brass is placed on three plugs in an auxiliary table fitted to the center of the slotter table and is held in place by a clamp nut fitted in the auxiliary plate as shown.

TOOL FOR TURNING ROCKER ARM BOSSES.

Fig. 2 shows a special tool for turning the bosses on rocker arms. A forked head is made on a tapered shank with a hole in the base of the fork for a centering pin. The tools are placed on the inside of the fork and are held in position by set screws.

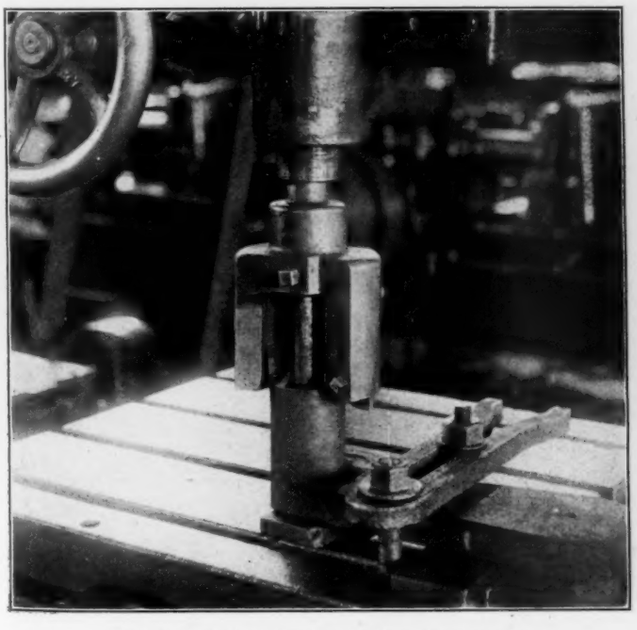


Fig. 2—Tool for Turning Rocker Arm Bosses.

AIR CLAMP FOR DRILL PRESS.

A pneumatic clamp for holding the work on a drill press is shown in Fig. 3. It consists of a 6 in. x 8 in. air cylinder, which

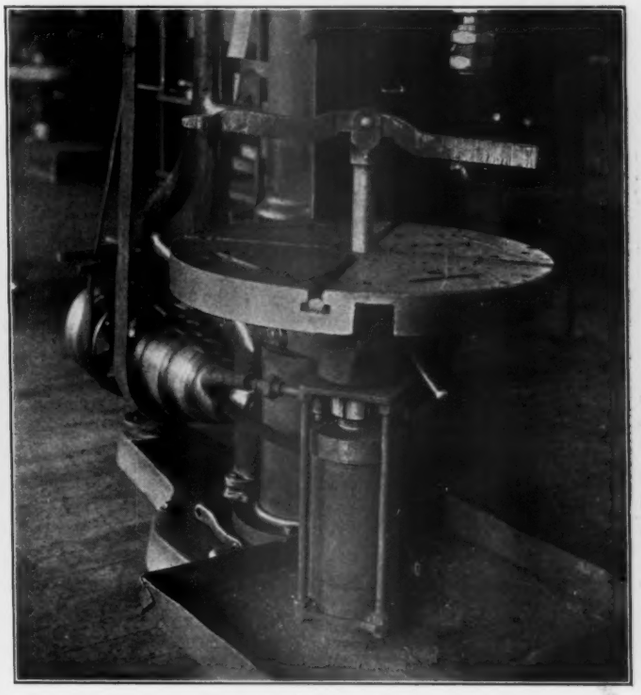


Fig. 3—Pneumatic Clamp for Drill Press.

is located directly beneath the table with the piston rod extending through it. The clamping rod is held in the upper end of the piston rod as shown; one end is placed on the work and the other on a block. A spring in the cylinder under the piston returns the rod to its original position when the air is released.

GRINDING THROTTLE VALVES.

A convenient method of grinding throttle valves is shown in Fig. 4. An air motor is carried on an old man fastened to a

Fig. 4—A Method of Grinding Throttle Valves by Power.

bench and turns the valve through an expansion shaft with two universal joints. The valve may be lifted from the seat while the machine is running, thus eliminating the possibility of grooving the seat.

PRESSING OFF SPRING BANDS.

A discarded wheel press fitted up and used for pressing off spring bands is shown in Fig. 6. After the band has been heated the spring is placed on a table with one end resting against a notched block as shown in the illustration. The plunger is equipped with a forked ram which forces the spring band from its position.

CYLINDER BORING BAR.

By using the bar shown in Fig. 5, any cylinder may be bored without removing the pilot beam or truck. It was built so as to

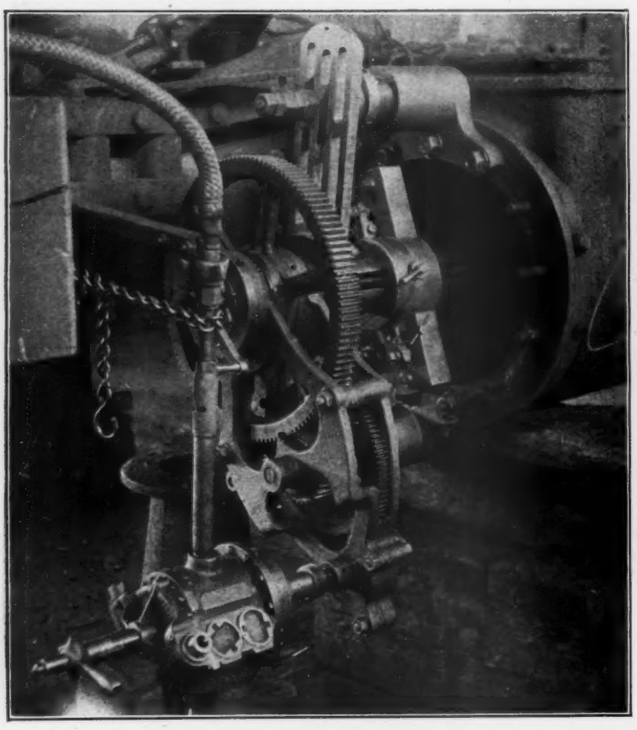


Fig. 5—Boring Bar for Cylinders.

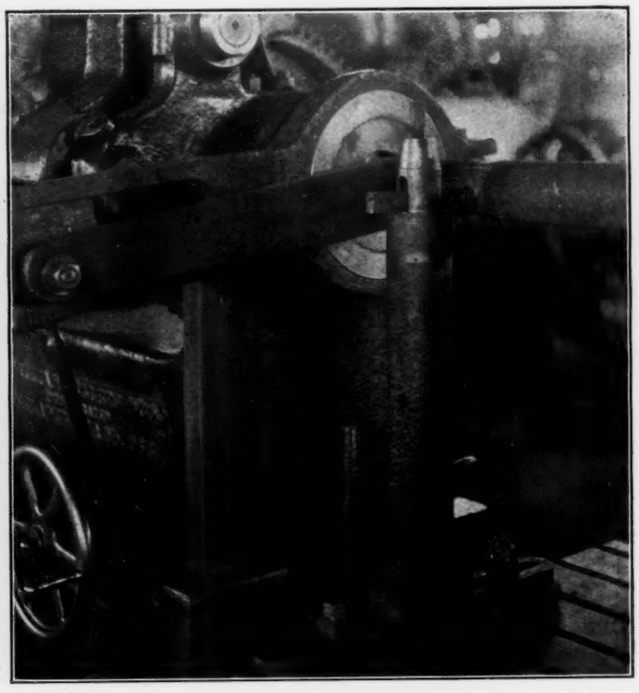


Fig. 7—Tool Post Used on Horizontal Boring Mill for Turning Tumbling Shafts.

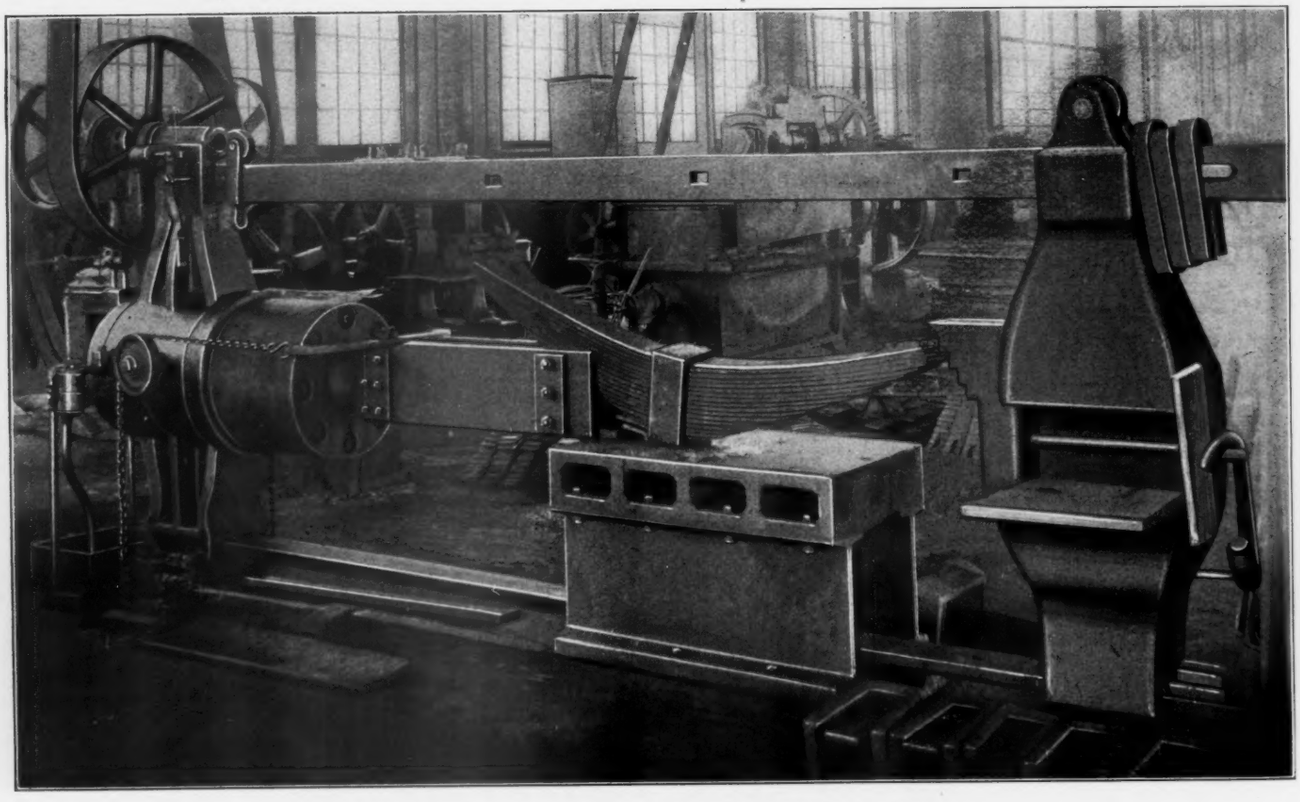


Fig. 6—Wheel Press Arranged for Pressing Off Spring Bands.

obviate the necessity of using offset tools to machine the back head and with it only straight tools are required. The bar is short, running in a taper gland adjusted by a center in the stuffing box. The construction and arrangement are clearly shown in the illustration.

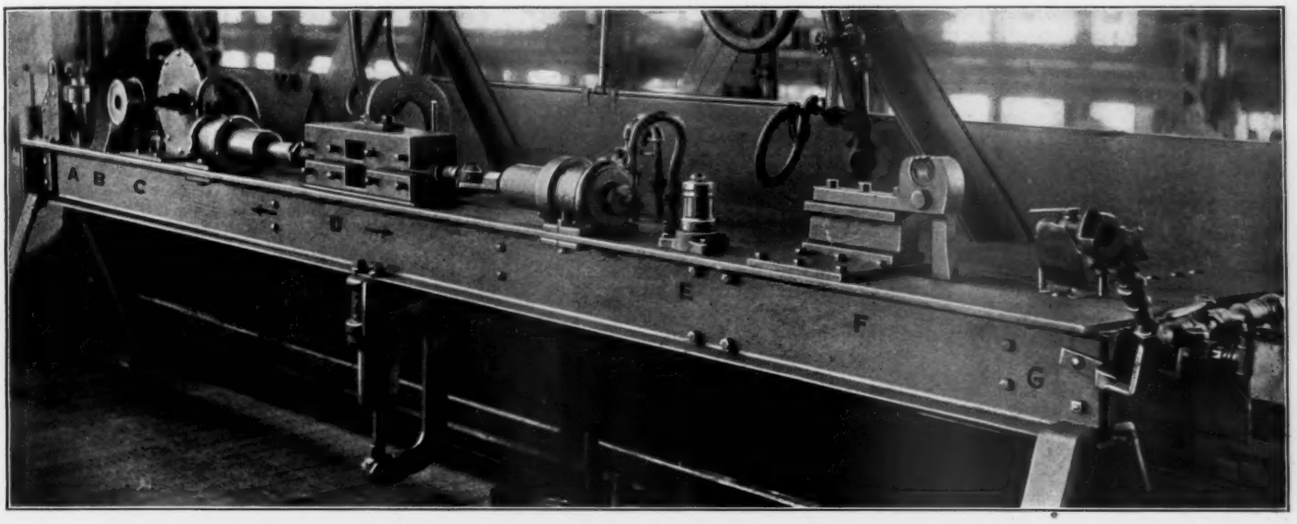


Fig. 8—Apparatus for Mounting Air and Steam Hose.

TOOL FOR TURNING TUMBLING SHAFTS.

The turning of the bearings on tumbling shafts is an awkward operation where some such tool as that shown in Fig. 7 is not used. This is simply a bar sufficiently long to allow the arms to clear the table, and sufficiently stiff to prevent chattering. It

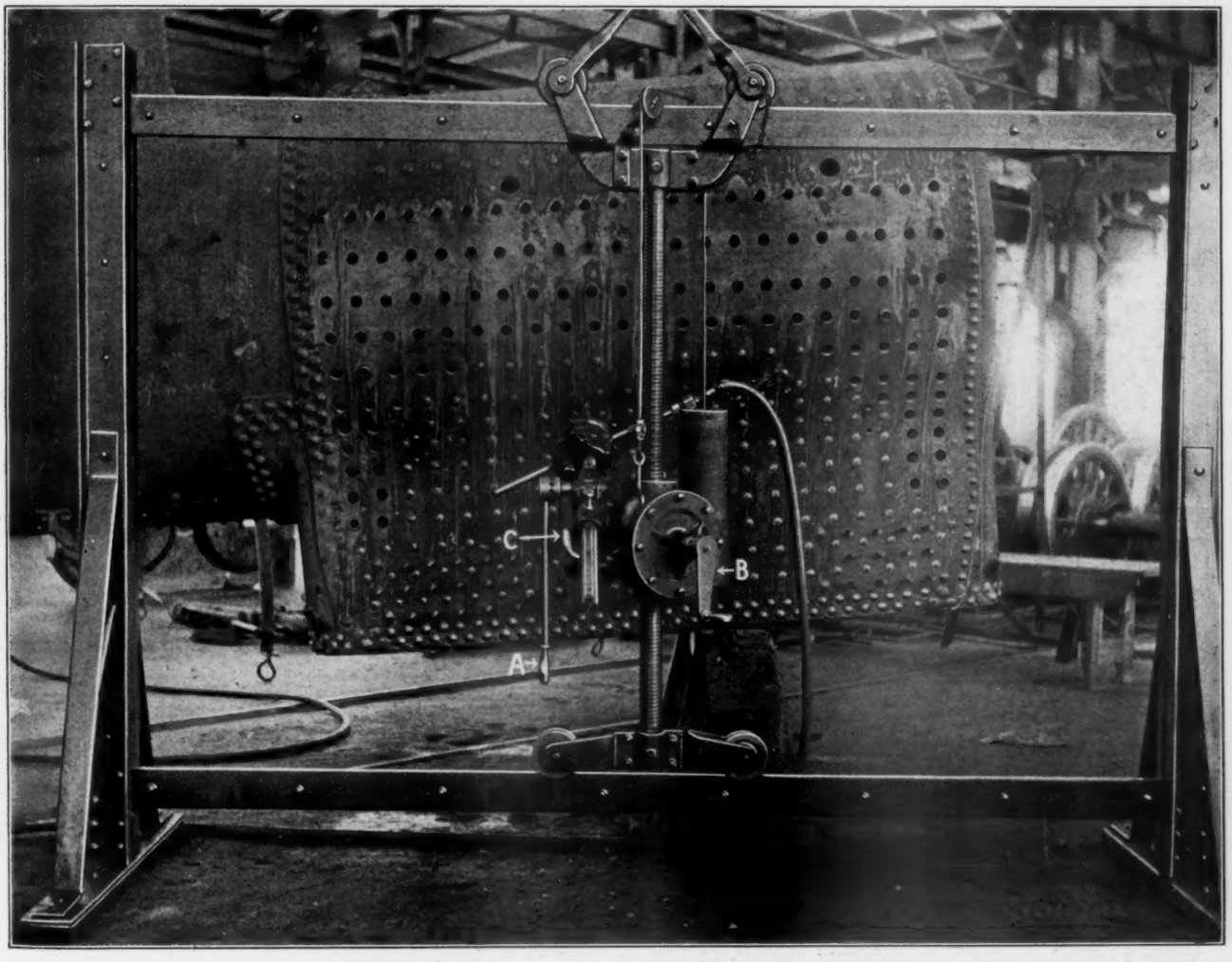


Fig. 9—Arrangement of Drilling Apparatus for Use on Boilers.

is used on a horizontal boring mill, the table being lowered, and operated by the longitudinal and transverse feed.

MACHINE FOR MOUNTING AIR AND STEAM HOSE.

The machine shown in Fig. 8 is a collection of devices for removing and replacing nipples and connections in air and steam hose. At the extreme left the machine *A* is used for breaking the clamp bolt; *B* is a tool for spreading the clamps open; *C* is an annular brush for cleaning the fittings; *D* is a vise for holding the new hose while the fittings are being forced in; *E* is a tool for cleaning the gasket grooves in the couplings; *F* is for tightening the clamp on the hose, and *G* is an air connection for giving the hose its final test. The outfit is neatly arranged on an I-beam and has given good service.

DRILLING HOLES IN BOILER SHELLS.

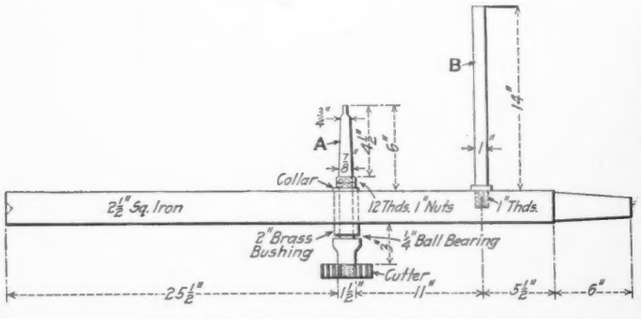
The boiler repair man knows what a difficult job it is to rig up an "old man" on the side of a boiler to drill out a staybolt, and the time lost in doing the work is considerable. The arrangement shown in Fig. 9 is intended to simplify this work. A frame made of structural shapes and bar iron is made as shown in the illustration, and carries a large vertical lead screw fixed in two two-wheel carriages running on the upper and lower bars. An air motor is fixed on the end of a shaft that is carried on a device operating on the vertical lead screw. The motor is adjusted in and out by the lever *A*, is raised or lowered by the lever B and it may be swung up or down, and held rigidly in position by the clamp *C*. In this way it is universal in its action and can be used in any position throughout the range of the frame for drilling out staybolts, drilling and tapping for studs, and for drilling holes.

MILLING ATTACHMENT FOR LATHES

BY E. L. SIEMANTEL,
Apprentice Instructor, Atchison, Topeka & Santa Fe, Amarillo, Tex.

A simple and useful appliance answering the purpose of a milling machine in small shops is shown in the illustration. It is made of a 2½ in. square rough iron rod, one end being turned to fit in the tailstock of the lathe; the other is centered to fit the lathe spindle.

The tool spindle *A* runs in a 2 in. brass bushing and has a



Milling Attachment for Use on Lathes.

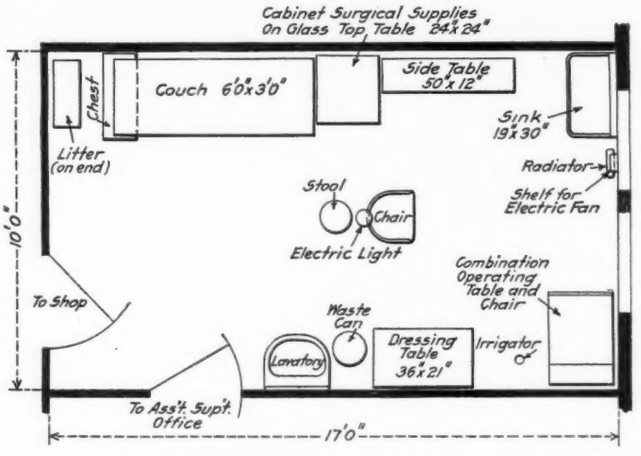
thrust ball bearing. It is held in position by two 1 in. nuts. One end is threaded to receive cutters of various sizes. It may be driven by either a belt or a motor, the post *B* being used as a brace for the motor handle when it is used. The work to be milled is attached to the carriage of the lathe and the various feeds are used as desired.

Altitude Record.—R. G. Garros, a French aviator, attained a height of 19,032 ft., exceeding the previous record by 1,151 ft.

Dead Weight of Vehicles.—The dead weight per passenger of a horse-drawn vehicle is between 300 and 500 lbs.; of a motor car, about 1,428 lbs., and of a steel railway coach, from 1,200 to 1,700 lbs.

SHOP HOSPITAL ROOM

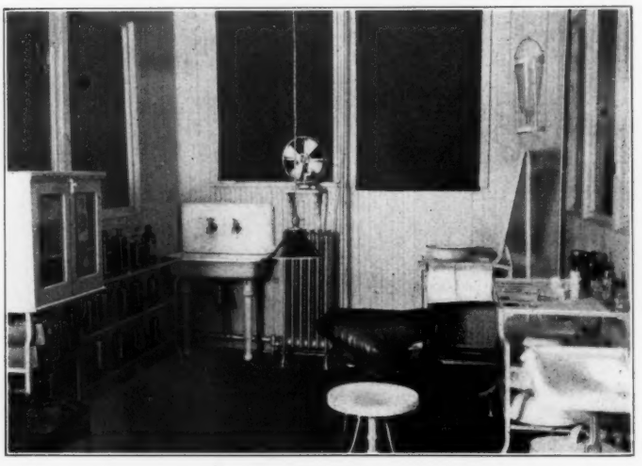
Along the lines of the "safety first" movement there is a certain feature that should not be overlooked, and that is a hospital or emergency room at the shops where the injuries of the employees may be carefully and antiseptically dressed. The illustrations show the emergency room of the Chicago, Rock Island & Pacific shops at Silvis, Ill. This plant employs about 1,400 men, and during the three years the room has been in service there has been



Plan of Hospital Room at the Rock Island Shops, Silvis, Ill.

no case where any man treated has been troubled with blood poisoning afterwards. All employees are required to report the slightest injury received and to have it dressed by the attendant in charge. In case of a serious injury the patient is given emergency treatment and is immediately carried to a hospital. There is a special man in charge of the room who is thoroughly familiar with the "first aid to the injured" rules, and is ready at a moment's notice to give aid. When he is not so occupied he assists in the assistant shop superintendent's office on clerical work.

The room is located just off the office of the assistant shop superintendent, and in the central part of the main shop. It is



General Arrangement of Hospital Room at the Silvis, Ill., Shops of the Rock Island Lines.

completely walled in and is kept in a clean, sanitary condition. All the fixtures are of enameled iron and glass. The walls and ceiling are painted with an enameled white so that they may be easily washed. The floor is completely covered with a single piece of linoleum, making it impossible for dust and dirt to collect in the cracks of the floor. A complete report of each accident

is made and placed on file. We are indebted to G. W. Seidel, superintendent of shops at Silvis, for the illustrations and the information.

MISCELLANEOUS SHOP KINKS

BY W. A. McGEE.

SMOKE STACK CRANE.

A simple crane arm to fit on locomotive stacks is shown in Fig. 1. It is made from a 2 in. round iron bar, which is looped over and welded at the end as indicated in the illustration. It

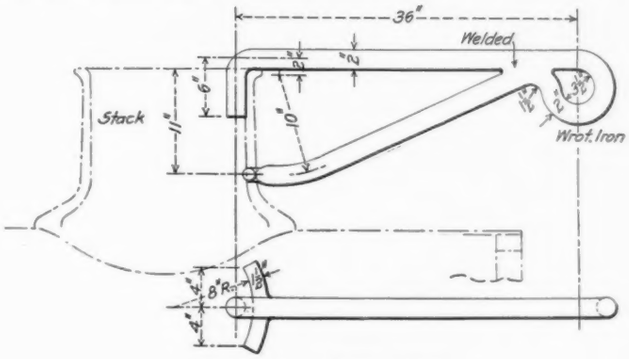


Fig. 1—Smoke Stack Crane.

is handy for applying smokebox fronts or doors, a chain hoist being attached to the end of the arm.

PNEUMATIC LOADING HOIST.

A convenient arrangement for loading or unloading cars is shown in Fig. 2. It consists of a trolley runway built up almost entirely of wood, and a 4-wheel trolley which carries the air hoist. The runway extends over three tracks, having a span of 38 ft., and in this way allows for loading from one car to another, or in case of unloading car trucks or mounted wheels, unloading from the car directly to the track over which they may be wheeled to the shops. The base of the trestle has a

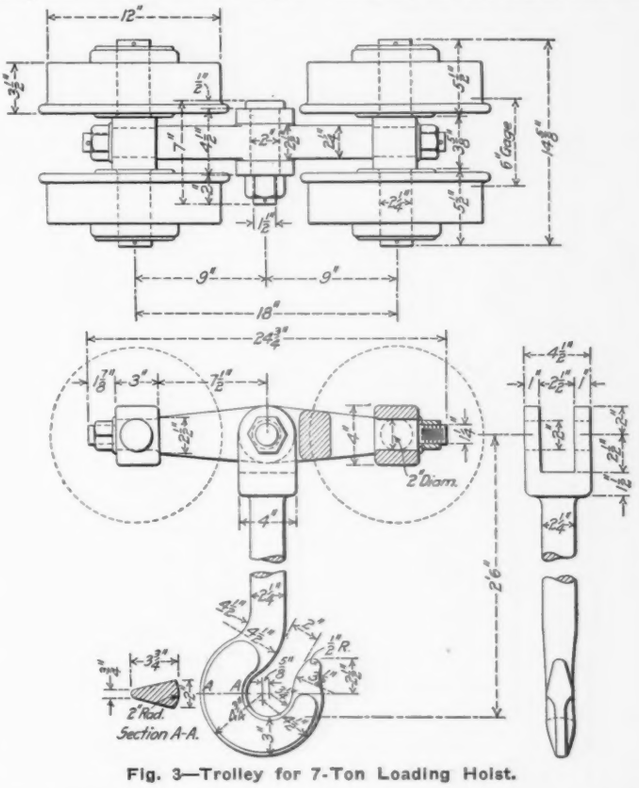


Fig. 3—Trolley for 7-Ton Loading Hoist.

spread of 16 ft., which provides the necessary stability, and the columns are made up of two 5 in. x 12 in. beams bolted

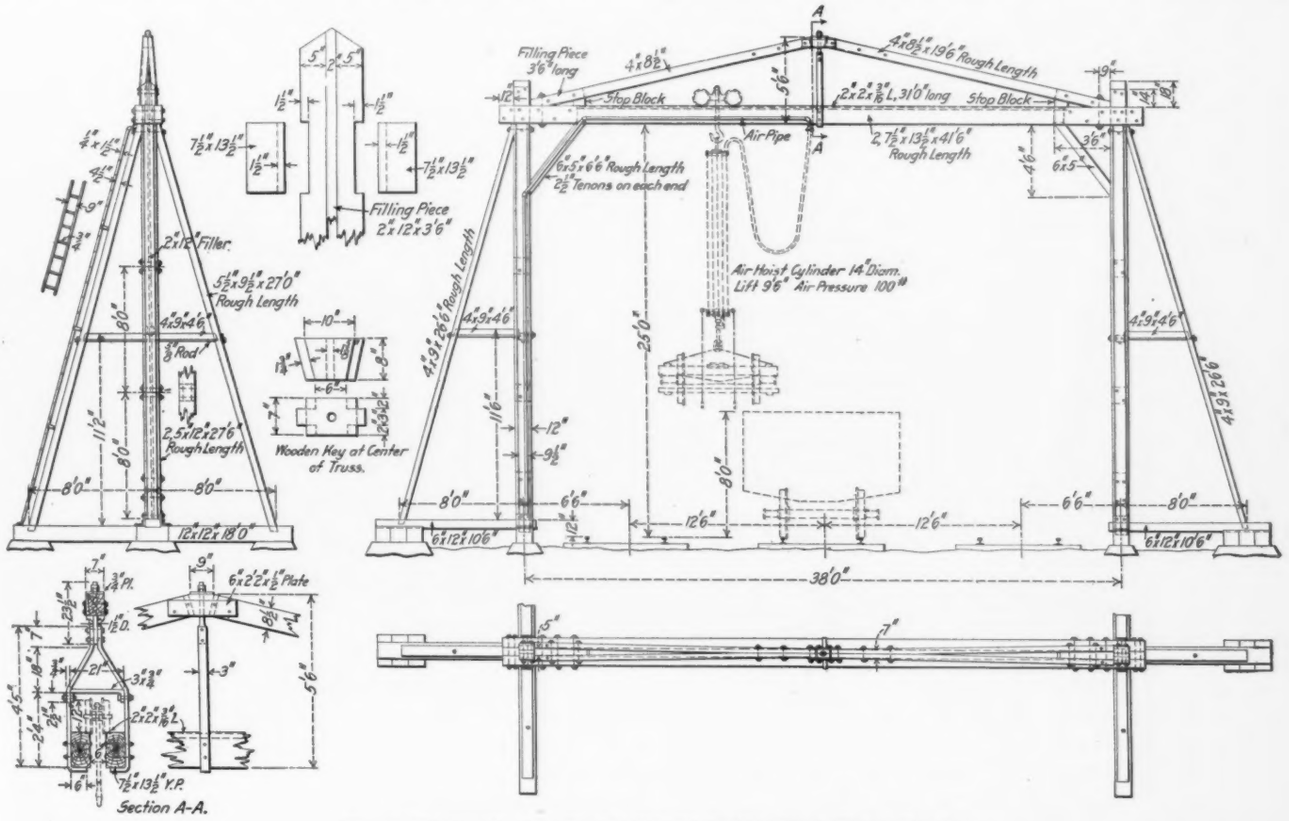


Fig. 2—Pneumatic Loading Hoist Operating Over Three Tracks.

together. The legs or braces are made of 4 in. x 9 in. stock, and are tied together 11½ ft. above the ground by a 4 in. x 9 in. beam with a ⅝ in. iron tie rod. The runway consists of two 7½ x 13½ in. beams, which are supported at the center by a yoke suspended from two diagonal braces of 4 in. x 8½ in. stock, extending over the runway and footing in the up-

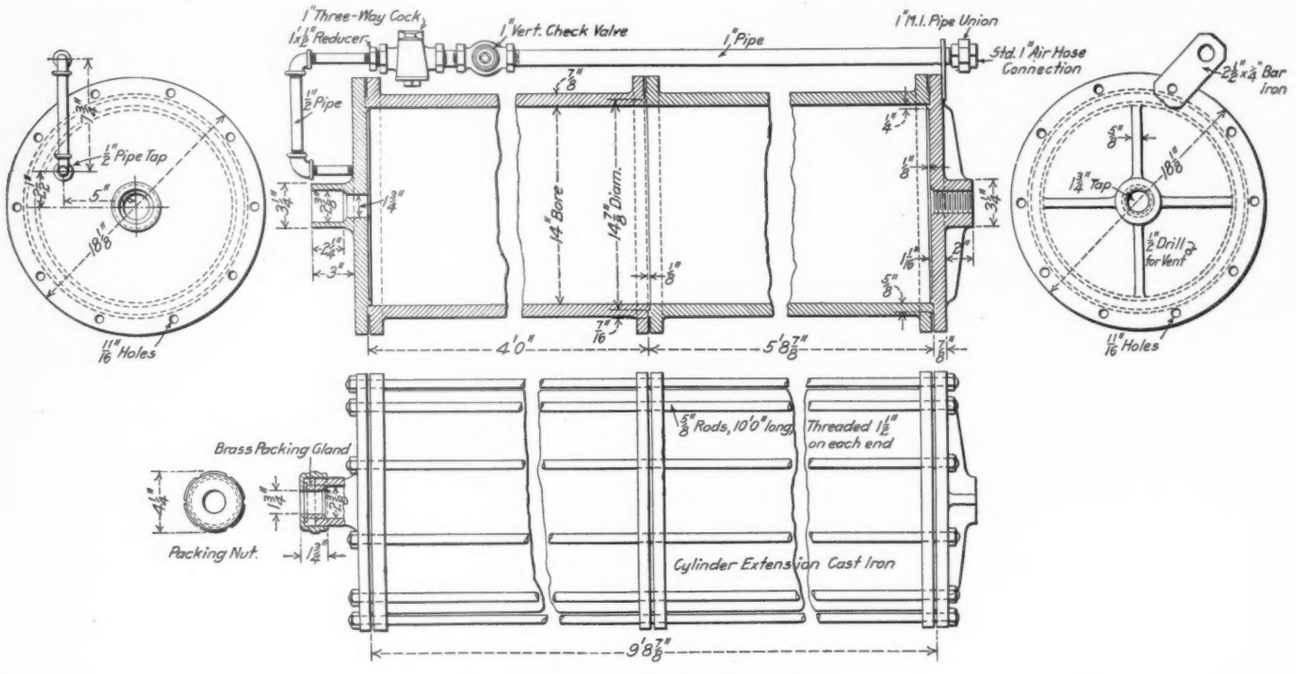


Fig. 4—Air Cylinder for Loading Hoist.

rights. The edges of the runway on which the trolley rolls are protected by a 2 in. x 2 in. x 3/16 in. angles. The trolley, as shown in Fig. 3, has four 12 in. wheels spaced 18 in. on centers, which support the carriage with the hook to which the hoist is attached. The air cylinder is shown in Fig. 4, and is 14 in. in diameter inside, and has a stroke of 9½ ft. It is made in two sections, one 4 ft. long and the other 5 ft. 8⅞ in. long; these are tied together by ten ⅝ in. rods. The details of the pis-

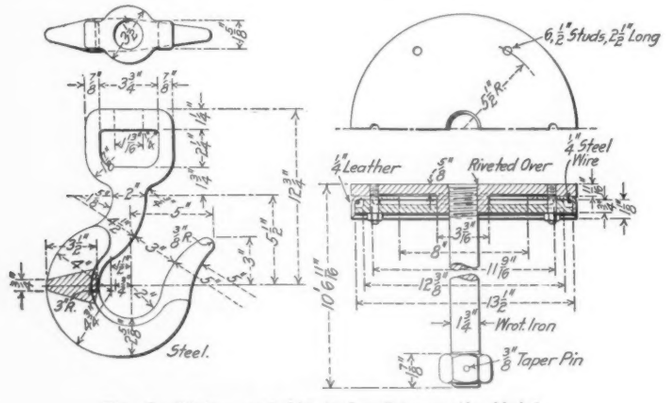


Fig. 5—Piston and Hook for Pneumatic Hoist.

ton, piston rod, and swivel hook which fits on the end of the piston rod are shown in Fig. 5. It will be noticed that the piston is packed with a leather cup washer which is held out against the cylinder walls by a ¼ in. steel wire spring. With an air pressure of 100 lbs. the hoist should easily handle 6 or 7 tons. It is operated from the ground, two chains extending down from the operating valve.

PORTABLE SAND BLAST.

A portable sand blast apparatus used for removing paint is shown in Fig. 6. It is made of a galvanized iron tank with ⅛ in. copper heads and 1 in. pipe with the necessary fittings. Air is admitted the top of the tank through a tee, the upper end of which is used for filling the tank with sand. The air pressure in the tank is throttled down to about 10 lbs. per sq. in. by a valve, as indicated, and the air pressure for the blast is regulated by the globe valve below the shop line connection. Two hooks are riveted to the sides of the tank so that it may

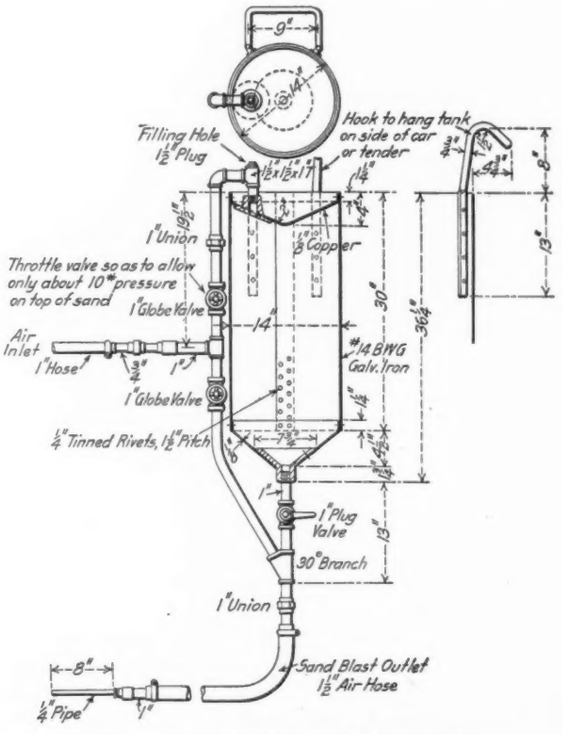

Filling Hole 1½" Plug
Hook to hang tank on side of car or tender
1" Union
⅛" Copper
Throttle valve so as to allow only about 10# pressure on top of sand
1" Globe Valve
Air Inlet
1" Hose
#14 B.W.G. Galv. Iron
1" Globe Valve
¼" Tinned Rivets, 1½" Pitch
1" Plug Valve
30° Branch
1" Union
Sand Blast Outlet 1½" Air Hose
¼" Pipe

Fig. 6—Portable Sand Blast Apparatus.

be hung on the side of the tender or at any place convenient to the work. The whole outfit can be easily carried by two men.

CAR DEPARTMENT

CABOOSE LAWS

The Special Committee on Relations of Railway Operation to Legislation, W. J. Jackson, chairman, has issued under date of December 10, 1912, bulletin No. 43, on legislation prescribing the construction of caboose cars as enacted in sixteen states. The accompanying table gives an analysis of these laws.

These laws do not apply to narrow gage lines in South Dakota; to logging roads in Washington; to roads of less than 15 miles in length with grades more than 200 ft. to the mile in New York; to passenger equipment used as a caboose in Nebraska, South Dakota and Virginia; to cabooses used in yard or transfer service in Illinois, Indiana and Iowa; to cabooses used on logging or lumber trains in Virginia and Wisconsin; to cabooses on work trains in Iowa; to cabooses used in original construction work in South Dakota; to unusual and unforeseen demands of traffic in Illinois and Indiana; to emergencies not exceeding 36 hours in Iowa; to cabooses used on account of accidents or casualty in South Dakota; to cabooses in service March 30, 1911, complying with the act except as to end doors and platforms in Missouri; and to cabooses in service April 25, 1910, complying with the act, except as to platforms if they are 20 in. wide, in Ohio. There are no exceptions made in the other six states.

ANALYSIS OF CABOOSE LAWS IN THE SEVERAL STATES.

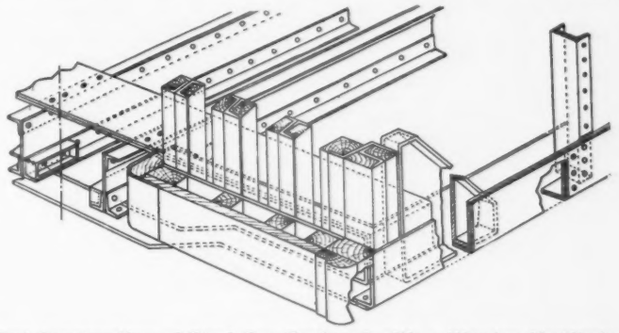
	Arkansas.	Illinois.	Indiana.	Iowa.	Michigan.	Minnesota.	Missouri.	Montana.	Nebraska.	New York.	North Dakota.	Ohio.	South Dakota.	Virginia.	Washington.	Wisconsin.
Height in feet	7	....	State Com.	....	....	....	....	....	11	....	....	....	....	....	....	....
Length in feet	24*	24	24	24	....	24	28	24	24	....	24	....	24	....	24	....
Strength (*A* means equal to 30-ton freight car constructed to M. C. B. standards)	A	....	A	....	....	....	....	....	A	....	A	....	A	....	....	....
Number of trucks and wheels	2—4	2—4	2—4	2—4	....	2—4	2—4	2—4	2—4	....	2—4	....	2—4	....	2—4	2—4
Platforms, inches wide (*S* means not specified)	24	30	24	18	State Com.	S	30	S	20	S	24	24	24	S	S	....
Doors (*B* means each end)	B	B	B	B	....	B	B	B	B	....	B	B	B	B	B	....
Guard rails (*R* means required)	R	R	R	R	....	R	R	R	R	R	R	R	R	R	R	....
Grab irons (*C* means required)	C	C	C	C	....	C	C	C	C	....	C	C	C	C	C	....
Steps (*R* means required; *E* means required with rod, board or guard)	E	R	E	E	R	R	R	R	E	....	E	E	E	R	R	....
Hand brakes	....	....	....	One	....	....	....	....	....	....	....	....	....	....	Each end	....
Air valve	....	....	....	Inside	....	....	....	....	....	....	....	....	....	....	....	....
Cupola (*R* means required)	R	R	R	R	....	R	R	R	R	....	....	....	R	R	R	....
Windows (*R* means required)	R	....	R	R	....	....	....	....	R	....	....	....	R	....	....	....
Closets (*F* means water; *G*, type not specified)	G	....	G	G	....	F	F	F	G	....	....	....	G	....	F	....
Penalties (dollars)	....	100 to 500	100 to 500	100 to 500	100 to 500	10 to 50	....	500 to 1,000	100 to 500	....	100 to 500	....	100 to 500	10 to 50	500 to 1,000	500 to 1,000
Existing equipment to be corrected (*H* means at general repairs)	H	....	H	H	....	....	....	....	H	....	H	....	....	....	....	....
Time extensions to be allowed by State Commission	....	....	1 yr.	1 yr.	....	....	....	....	1 yr.	....	1 yr.	1 yr.	1 yr.	....	....	....
Enforcement of act (*J* means at discretion of State Commission)	....	....	J	....	....	....	J	....	....	....	....	....	....	....	....	....
Date effective	Jan. 1, 1913	1909	June 1, 1914	1912	1910	1909	1911	1907	June 1, 1914	1909	June 1, 1914	1910	1911	1910	1910	1910

*Including platform.

A COLLAPSIBLE END CONSTRUCTION FOR PASSENGER EQUIPMENT

The advisability of attempting to make a collision-proof end for passenger cars has been held in question by many designers, who claim that such a construction cannot be produced without making the weight of the car excessive. An alternative which has been sometimes suggested is a construction that will absorb the shock of a collision by crushing, before serious damage can be done to the car body.

The Barney & Smith Car Company, Dayton, O., has recently developed, and applied for letters patent on, a construction of this type. In this device the platform and vestibule are so constructed and attached to the car that they will collapse in case of a collision. This gives a shock absorbing distance between

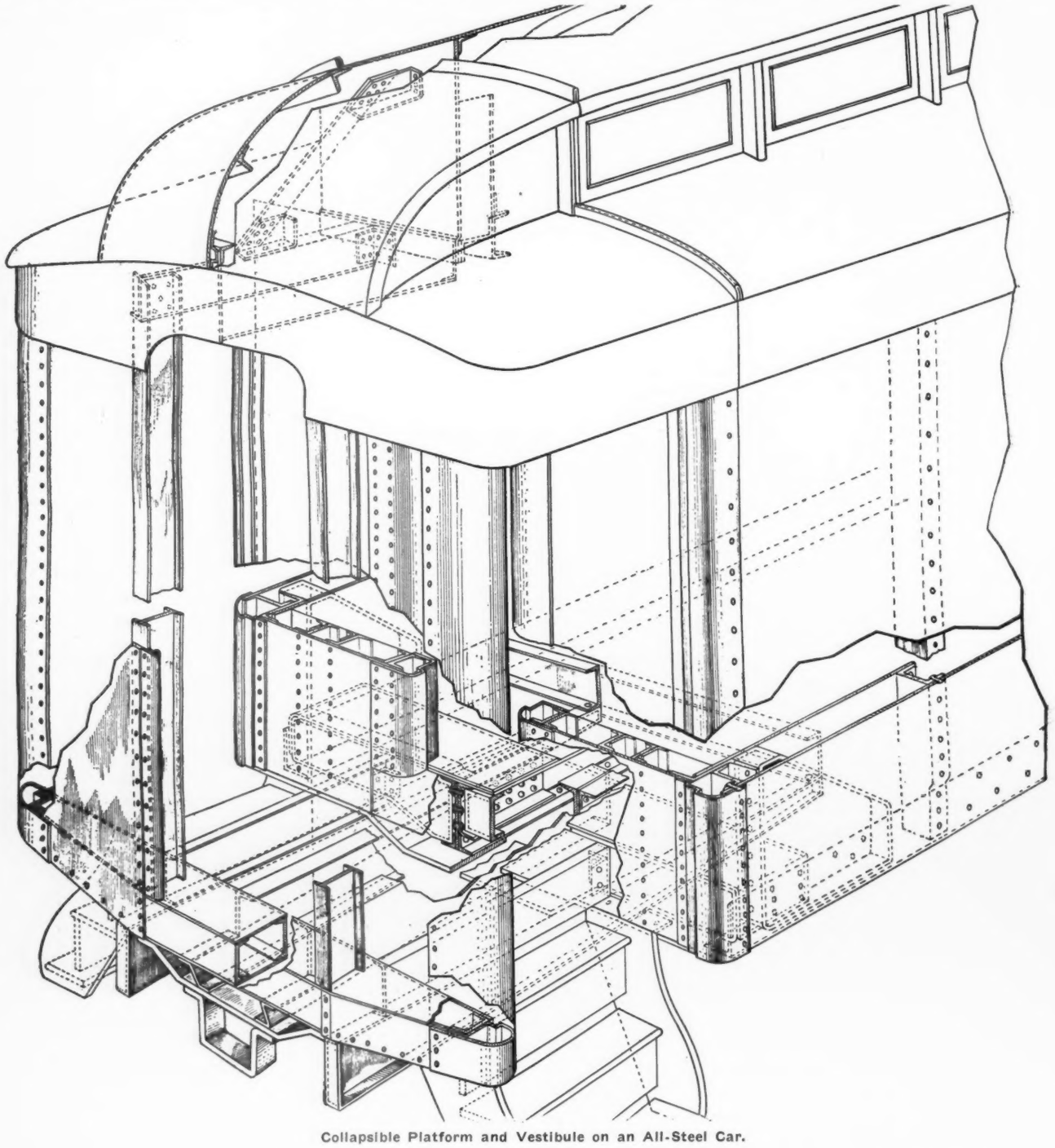


End Construction of Steel Car Equipped with a Wooden Vestibule.

two cars equal to the combined depth of the platforms. To accomplish this, the center sills are run only to the end of the car body, and the connection between them and the platform sills is made of such strength that it will give way when anything greater than the maximum service shock is received on the outer end of the vestibule. The steps, vestibule door and hood will of course collapse when the rivets shear on the sill extensions, and these will assist in absorbing the energy of the shock. The end of the car body is designed for great strength, heavy sections being used for the end posts. It is generally claimed that in the case of cars attempting to telescope, the point of greatest shock is never over 20 in. above the floor line, and with this in view the intermediate posts are reinforced for a distance of about 4 ft. above the floor by angles riveted to the inside. The end of the car is further protected by pressed steel triangular shapes about 30 in. high, placed at the sides, as shown in the illustration. In order to hold the end posts in position, and also to prevent parts of the vestibule piercing the end of the car, it

is covered entirely by a heavy steel plate, which is attached to the roof and extends to the bottom of the end sills. It is claimed that this plate, in case the entire shock of a collision is not absorbed by the collapsible vestibule, will tend to pull the roof of the car down and throw the next car up instead of allowing the two cars to telescope. Pressed steel shapes are also placed below the platform end sill, forming a part of the collapsible vestibule, and are designed to act as an anti-climbing device. Heavy I-beams are used as vestibule center posts. These are securely riveted above and below and it is believed that in case of one car attempting to ride over the other, these beams would be of sufficient strength to cause the rivets connecting them to the sill extensions to shear off.

One of the illustrations shows a car constructed entirely of steel. A collapsible construction of wood has also been designed, which may be applied to car bodies of either steel or wood construction. As shown in one of the illustrations, in applying this type to a car of steel construction an auxiliary end of wood is used. This makes two walls at the end of the car, one the regular car end reinforced with wood, and the other the vestibule wall which rests directly against the end of the car. The entire platform, vestibule, hood and sill extensions are constructed as a unit, detachable and separate from the car body proper and can be applied, if necessary, after the car is built. It is presumed that in case of a collision these would be the only parts seriously damaged, and the car could therefore be repaired and replaced in service with a minimum of expense and delay. The object of the entire device is to protect the car body from damage.

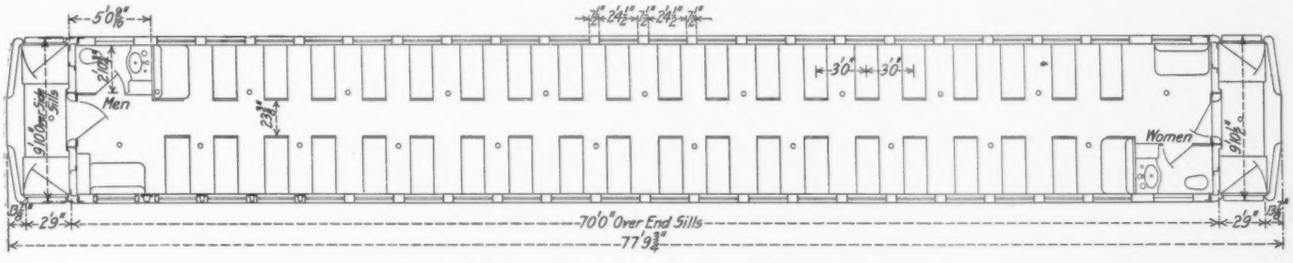


Collapsible Platform and Vestibule on an All-Steel Car.

NEW YORK CENTRAL LINES STEEL COACHES

Strong End Construction and Thorough Insulation Distinguish the New Passenger Equipment.

The new all-steel passenger train cars recently put in service on the New York Central Lines are 70 ft. in length over the end sills and 77 ft. 9¾ in. over the buffers. The coaches have a seating capacity for 84 passengers. These cars can be considered as representing the latest development of steel passenger equipment for heavy trunk line service along conservative lines. Two features of the design are particularly noticeable, viz.—the exceptionally complete arrangement of insulation and the substantial end construction, both of the car body and of the vestibule. There are very few places anywhere in the car where the two designs. The posts terminate at the plate and the lower deck carlines are in separate pieces. The posts, which are all practically of the same section, are equally spaced throughout the length of the car except at the point where the saloons are installed. The interior finish is of steel except below the window sills and on the ceiling where agasote is employed. The steel is finished to imitate mahogany and the window sills and window sash are of Cuban mahogany. The passenger coaches are equipped with the axle light system and, including the batteries and battery boxes, have a total weight of 142,000

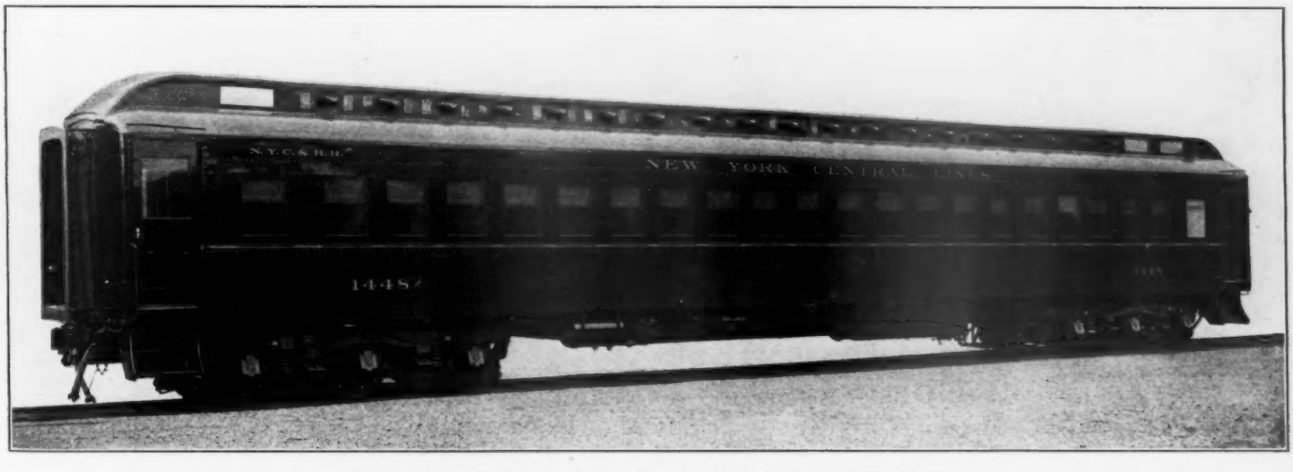


Plan of 70-Ft. Steel Coach; New York Central Lines.

there is a continuous metal contact between the exterior and interior, and careful provision has been made to prevent the entrance of cold air between the outside and inside sheathing or finish. A 2¾ in. air space has been provided under the floor which is sealed at the bottom by three-ply insulation secured to ⅛ in. steel plates arranged in comparatively small removable sections.

Six inch I-beams, set in pockets in a cast steel underframe and securely held at the top, are employed for both the door posts and the vestibule diaphragm posts. In addition the 6 in. lbs., giving a weight per sq. ft. of interior floor area of 22.9 lbs. and per seated passenger of 1,690 lbs. Cars of the design shown herewith have been built by the American Car & Foundry Company and the Barney & Smith Car Company, the design being prepared jointly by the engineers of the railway and of the builders.

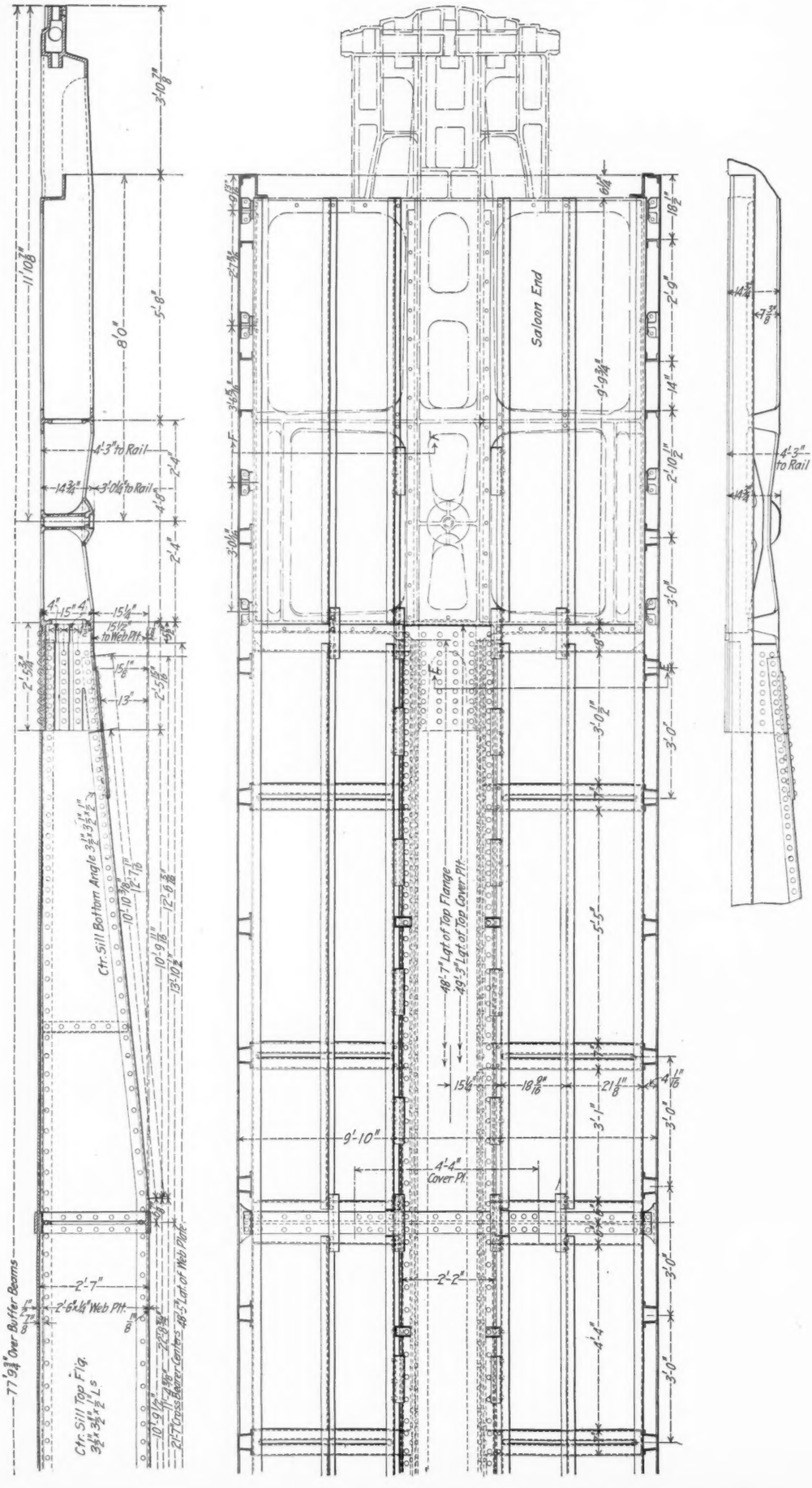
The center sills connecting the two large steel castings at either end consist of two plate girders set 18 in. apart, each having a ¼ in. web plate and two 3½ in. x 3½ in. x ½ in. angles at the bottom and one 3½ in. x 3½ in. x ½ in. angle at



70-Ft. Steel Passenger Coach for the New York Central Lines.

Z-beams forming the corner posts are braced by a substantial cast steel knee resting in a machined pocket in the underframe. This construction is such as will evidently offer the most determined resistance to telescoping of the car body. An underframe somewhat similar to that employed by the Pullman Company for steel sleeping and parlor cars is used. It consists of a Commonwealth combination cast steel double body bolster, end sill and platform connected by fish belly type center sills and side sills of steel angles.

In other respects, however, there is little similarity between the top. These girders are 31 in. in depth at the middle for a length of 22 ft. 8¾ in. They taper at each end for a distance of 12 ft. 10⅛ in. to a depth of 13 in. A top cover plate, ½ in. in thickness and 26 in. wide, is secured to both sills and overlaps for the full length of the splice at the steel castings. There is also a splice plate on the under side of each sill at this point which is ⅝ in. in thickness by 7¾ in. wide and 3 ft. in length. All the angles on the center sills are continuous for the full length of the web plate with the exception of the inner angle on the lower edge which does not form part of the splice

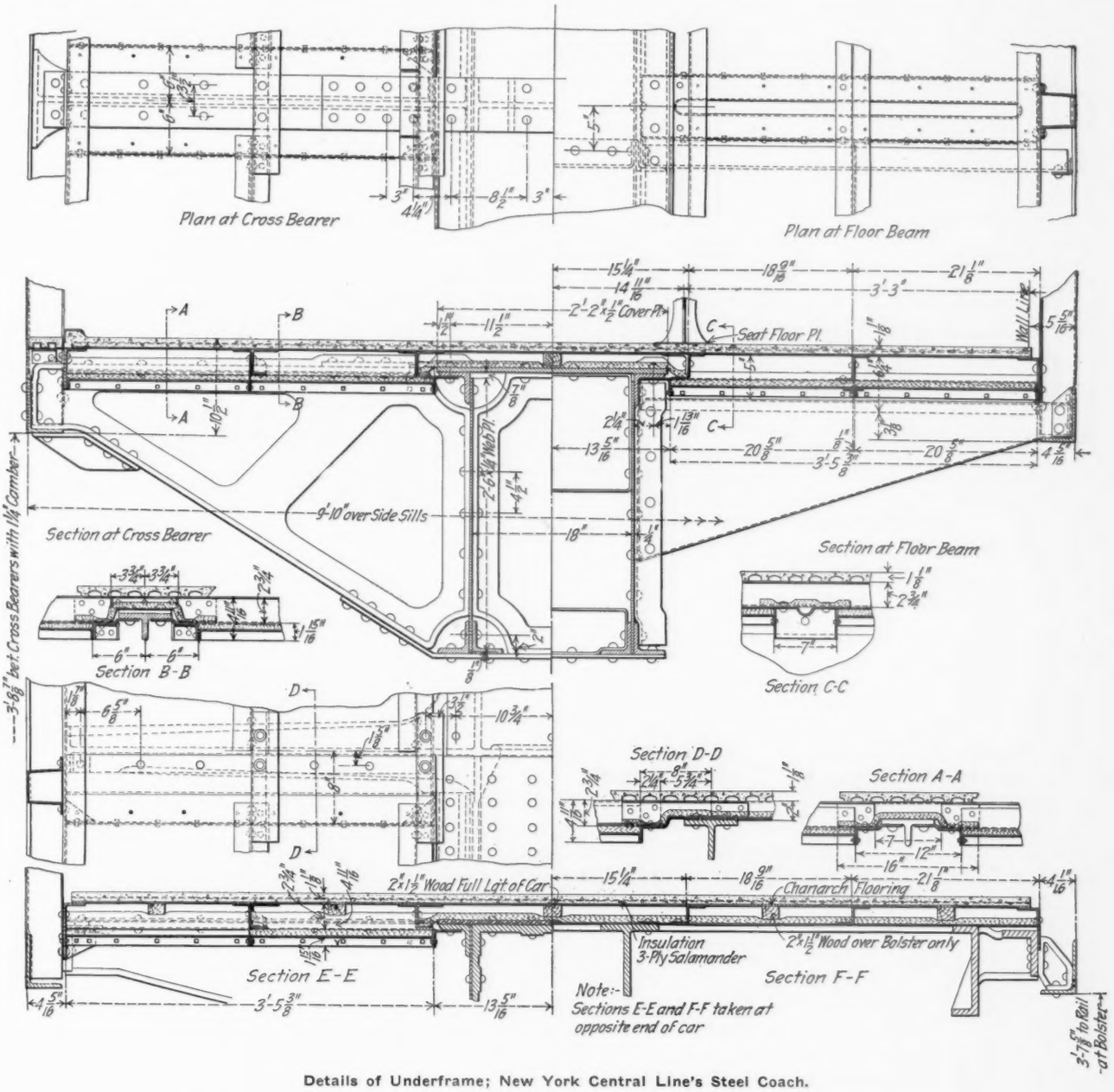


Arrangement of the Members of the Underframe; New York Central Line's Steel Passenger Cars.

to the casting except as it is secured through the medium of the bottom cover plate. The web of the center sill is provided with four vertical stiffeners of 3 in. x 3 in. x ¼ in. angles which extend the full depth of the sill and are spaced equidistant between the cross bearers and the cross tie and one in each panel between the cross bearer and the bolster.

The center sills are made with a 1¼ in. camber by shearing the web plates tapering from the cross bearers to the ends. All rivets in the center sill construction are ¾ in. and are pressed steel center sill separator in two pieces and a pair of pressed steel crossties all made of ¼ in. plate flanged on all sides. The form and arrangement of this structure is shown in one of the sections.

The side sills are 6 in. x 4 in. x ⅜ in. rolled steel angles extending in one piece for the full length of the car, being securely riveted to the bolster castings and to the cross bearers and cross tie. They are set with the flanges extending inward and are fastened by eight horizontal rivets and two vertical

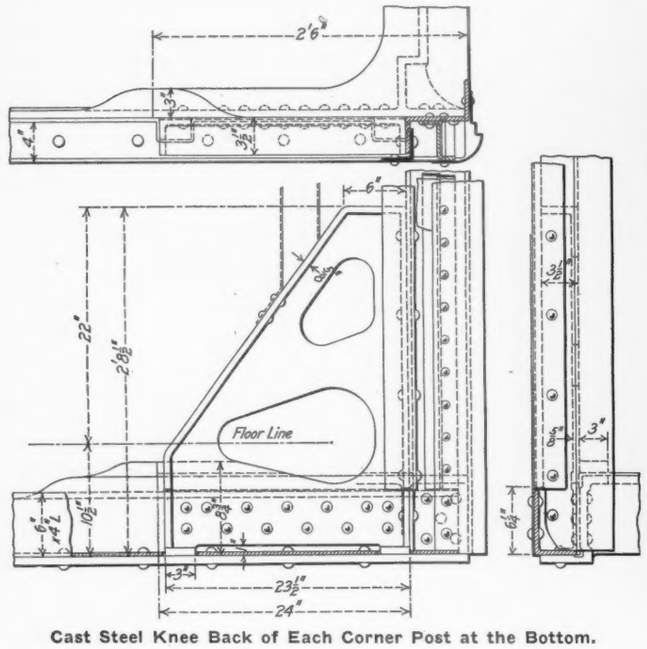


Details of Underframe; New York Central Line's Steel Coach.

spaced at 1½ in. pitch wherever they connect to the web plate. The cast steel cross bearers are spaced 21 ft. ⅞ in. apart, coming at the point of tapering of the center sills; they are formed in three pieces, properly shaped for fitting between the center sills and between the side and center sills. They are cut out for lightness as shown in the illustration, and have top and bottom cover plates 6 in. x ½ in. x 4 ft. 4 in. in length, which extend continuous over the top and bottom of the center sills and are securely riveted to the flanges of the cross bearers and of the center spacing plate. At the center of the car is a rivets at each cross tie, the connection at this point also being reinforced by a separate casting coming underneath the side sill. The bottom of the side sill is 3 ft. 7⅝ in. above the rail.

In addition to the cross tie and cross bearers there are seven pressed steel, channel shaped, floor supports on each side, secured between the center and side sills. These are formed of ⅛ in. plate and are 7 in. wide with 3½ in. flanges. They are further stiffened by a groove 1½ in. wide x ¾ in. deep pressed in the middle for the full length and are located adjacent to side posts in each case. They have a maximum spacing of

6 ft. The outside floor stringer consists of an angle, pressed from ¼ in. plate, extending for the full length of the car and riveted to the side posts with four ½ in. rivets at each post. The lower edge of this angle acts as a support for the false floor. Intermediate stringers of Z shape, pressed from ⅛ in.



Cast Steel Knee Back of Each Corner Post at the Bottom.

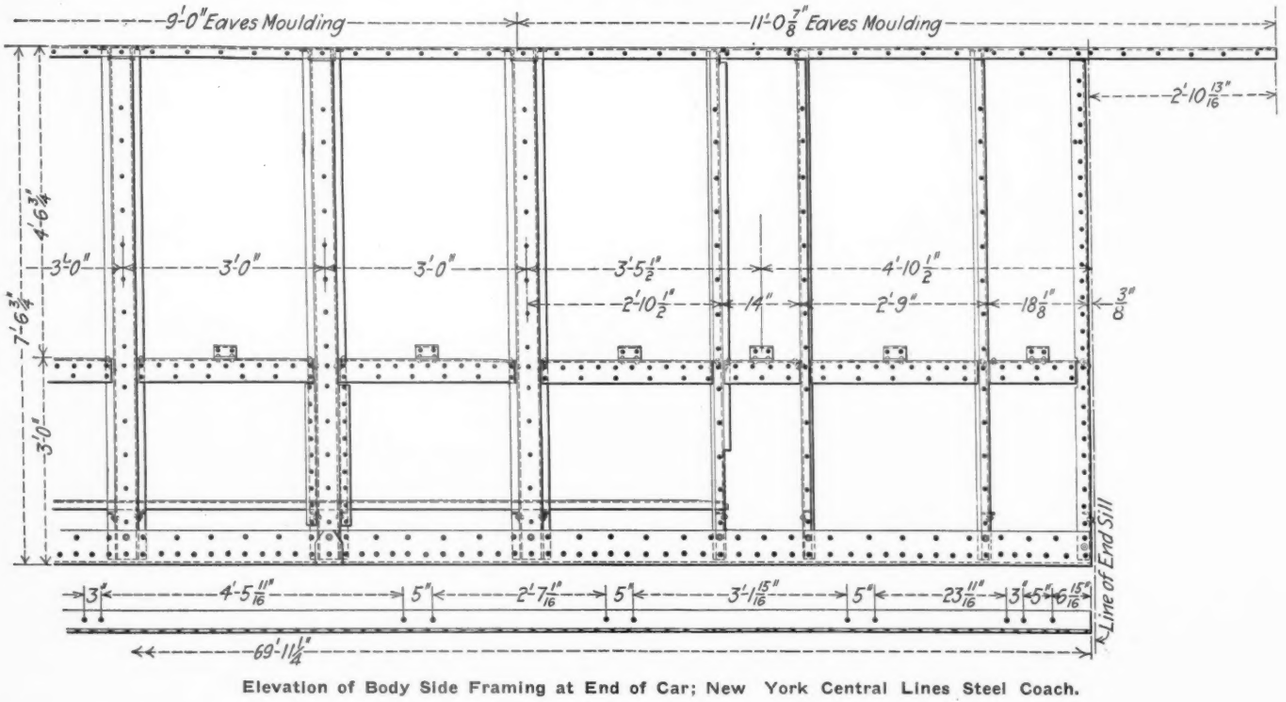
plate, extend for the entire length of the car. They are in five parts with proper shaped connection pieces at the cross bearers and bolsters and are riveted to the floor support with two ⅜ in. rivets at each connection. A ⅛ in. extension plate is riveted to each of these stringers and extends downward for

resting on the center sill cover plate and located midway between the floor supports.

The side sill, formed of a 6 in. x 4 in. x ⅜ in. angle; side

Interior of 70-Ft. Steel Coach; New York Central Lines.

posts pressed in channel section, with flanges, from ⅛ in. plate; a 5 in. 6.5 lb., channel, continuous for the full length of the car, forming the plate; and a ⅝ in. x 4½ in. belt rail form the principal members of the side framing. The posts are shaped



Elevation of Body Side Framing at End of Car; New York Central Lines Steel Coach.

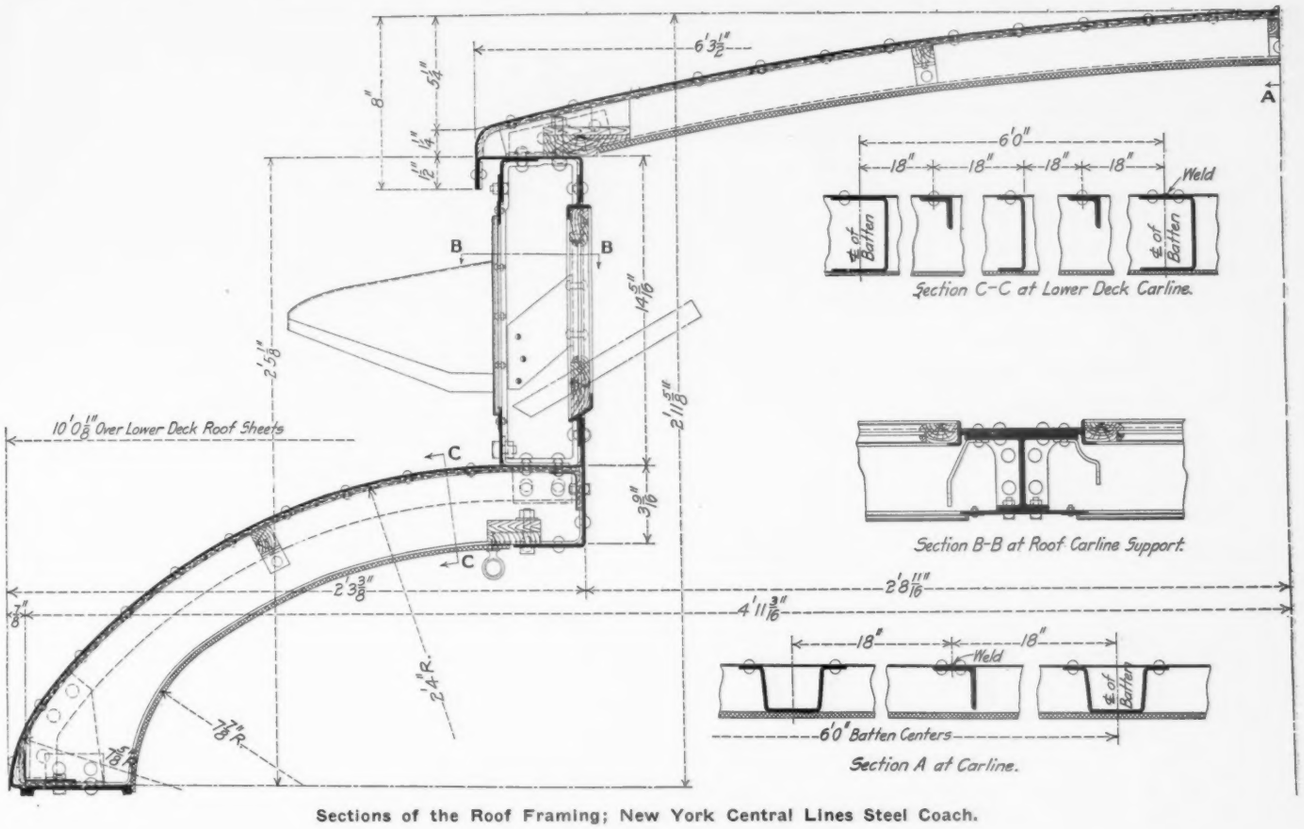
securing the false floor. The middle floor stringers are also Z shape and of ⅛ in. plate. At each seat pedestal a 3½ in. x 2½ in. x ¼ in. angle, 13 in. long, is riveted to the stringer which has an extra support in the shape of a pressed steel gusset

at the bottom to fit inside the leg of the angle and are cut away at the top to clear the flanges of the channel plate which is placed with its web horizontal and flanges extending downward. The posts have a 1/16 in. cover plate riveted to the outwardly

extending flanges, thus giving a full box section. The joint at the side sill is made with two ½ in. rivets through the posts, in addition to the exterior ⅛ in. sheathing. At the plate are two pressed 3/16 in. angles fastened with ⅜ in. rivets. On account of the width of the window panels at the ends of the car, three special posts of simple channel section are used.

Back of the belt rail which extends continuous outside the posts and in one piece for the full length of the car body, are 4 in. x 4 in. x 3/16 in. pressed steel angles fitting between the posts and secured to them by 3/16 in. connection angles. The side sheathing comes between the belt rail and these angles and the three are secured with ⅜ in. rivets. The upper row of these rivets also secures the outer edge of the window stooling which is pressed from 3/32 in. plate and covers the upper part of the belt rail. It is continuous for the length of the car, being cut out to clear the posts. Z-shaped pieces, attached to the belt rail stiffeners, support the stooling between the posts. Other longitudinal members in the side framing consist

The lower deck carlines are pressed in channel shape from ⅛ in. plate, to the contour shown in the illustrations. They have flanges 1¼ in. wide except where the roof sheet joints are made when the flanges are 2⅝ in. deep. A carline is located over each side post and they are secured to the side plate with four ⅜ in. rivets where they have wide flanges and two ⅜ in. rivets and a ⅛ in. pressed angle where the narrow flanges are used. Spaced midway between these are the intermediate lower deck carlines formed of 1½ in. x 1½ in. x 3/16 in. angles. These are intended principally as roof sheet stiffeners. At the upper end the carlines are fastened to the combination deck sill and plate formed of a ⅛ in. sheet flanged with a web 18 in. wide, a lower flange 3⅜ in. wide, and upper double flanges of 5 in. and 1½ in., respectively. The web is cut away for the deck windows, the openings being 10 in. x 30⅝ in. This plate is continuous for the length of the car body and its top flange is stiffened by a 1¼ in. x 1¼ in. x ⅛ in. angle located as shown in the section of the car. At each carline



Sections of the Roof Framing; New York Central Lines Steel Coach.

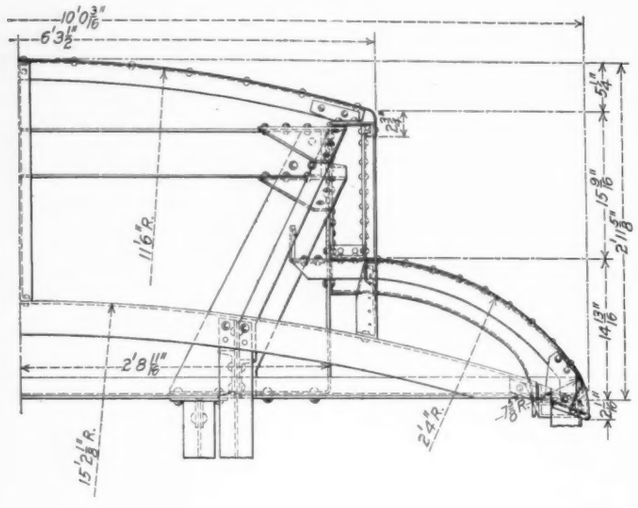
of a 3½ in. x 2½ in. x ¼ in. angle secured inside the posts for a seat rest and a floor cove molding of ⅛ in. plate in an inverted J shape.

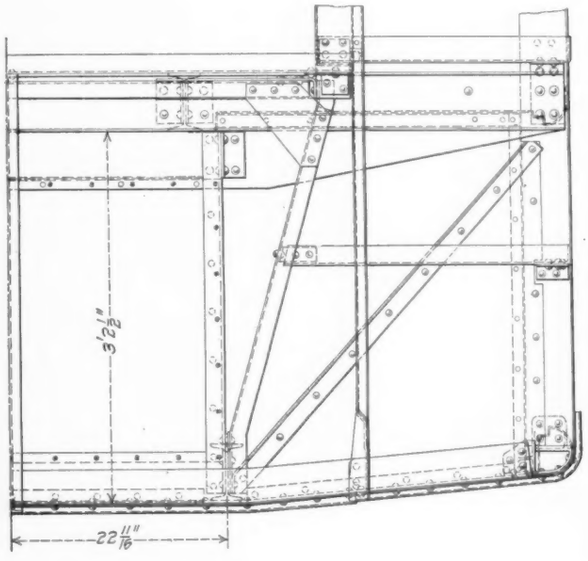
A 6 in., 15.6 lb., Z-bar is used for the body corner post and sets in a pocket in the underframe casting at the bottom and is secured to both the side and end plates at the top. This post is backed by a large cast steel knee extending back along the side of the car for a distance of 23½ in. and reaching as high as the belt rail. This anti-telescoping arrangement was furnished by the Commonwealth Steel Company. The door posts are 6 in., 12¼ lb. I-beams, and are also set in properly shaped pockets in the underframe casting. They are securely fastened at the top to the end plate which is made of a 5 in., 6.5 lb., channel set with the web horizontal. This plate is secured to the side plate and the deck sill by a gusset bracing and is further reinforced with a wide stiffener. The intermediate end posts are 4 in., 8.2 lb. Z-bars, secured at the top and bottom in the same manner as the side posts.

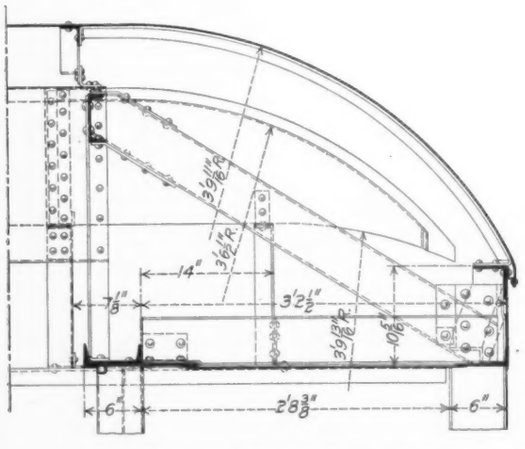
connection a malleable iron stiffener is inserted. These are shaped to also carry the screens and the ventilators. Ward ventilators are used in the main part of the car and Globe ventilators at the toilets. There are thirty-eight of the former and two of the latter type.

On the upper deck the carlines are of ⅛ in. plate flanged channel shape, 2⅛ in. deep and 5 in. wide over the flanges. These are formed to an 11 ft. 6 in. radius and are located with the same spacing and directly above the main lower deck carlines. They rest on top of the combination deck sill and plate and are secured to it with four ⅜ in. rivets at each end. Between these main carlines are intermediate deck carlines formed by 2 in. x 2 in. x 3/16 in. angles shaped to the proper contour. These are inserted for the purpose of making the joint of the roof sheets, which are riveted to them with ¼ in. rivets spaced not over 5 in. apart. The roof sheet on the upper deck is of No. 14 B. W. G. steel plate and the joints between the sheets are welded. The eaves of the upper deck are made by riveting

the roof sheet to the down-turned flange of the deck plate. On the lower deck the roof sheets are of 1/16 in. steel plate, except at the ends where a thinner plate is employed. The lower roof sheets are also held with ¼ in. rivets and are welded at

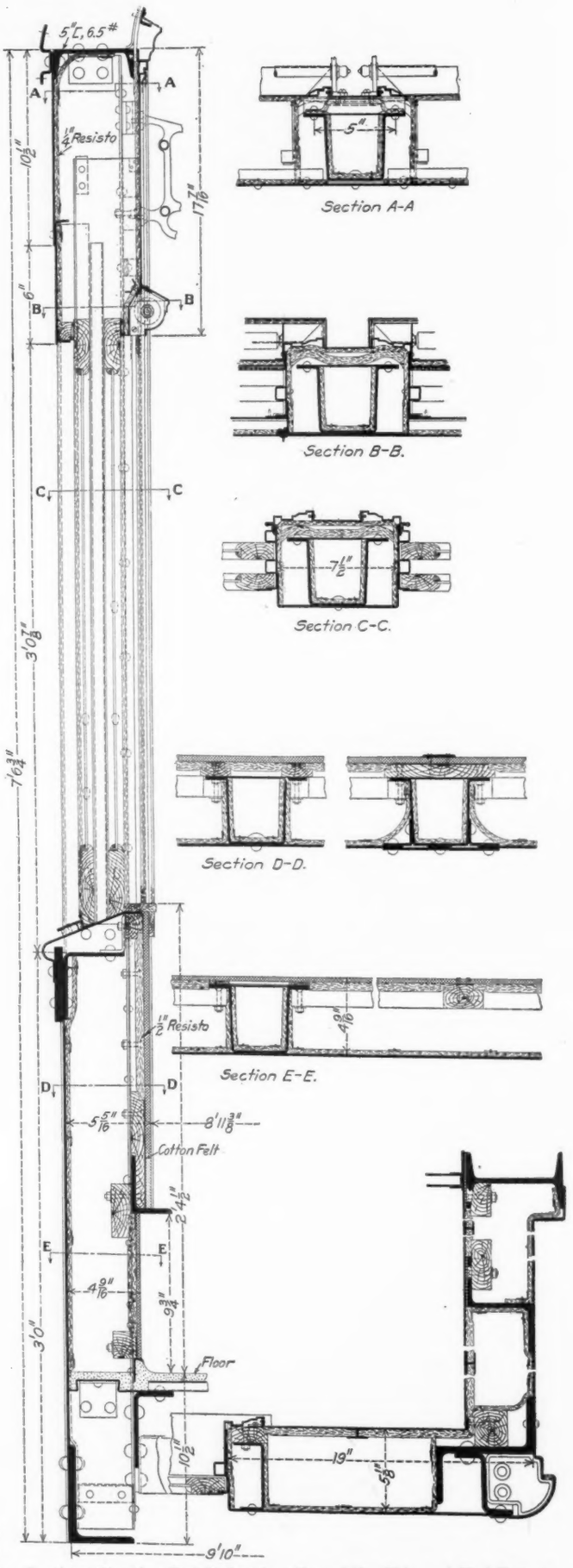






Detail of Upper Framing at the End of the Car.

the joints. The lower deck eaves are formed by a special flanged eaves molding of ⅛ in. plate. This molding is riveted to the lower part of the roof sheet and through the flange of the body



Sections Showing Detail Construction of the Side and End Frame.

side plate. It is continuous on both sides and ends of the car.

The vestibule diaphragm posts are also 6 in., 12¼ lb. I-beams, set in pockets in the steel casting in the same manner as the door posts. They are supported at the top by a 5 in. channel extending straight back to the end frame and secured to the gusset which reinforces the end plate. It also abuts the flange of the end plate. There is also a similar channel secured to the opposite side of the post, which extends upward and outward to a connection at the junction of the deck end plate and side plate. The former is a 5 in. straight channel with the flanges cut away at the end and the web turned inward for riveting to the deck side plate. There is also a diagonal brace from the top of the door post at this same point and large gusset plates make the joint rigid and strong. Furthermore there is a diagonal brace from the top of the vestibule diaphragm post to the side plate near its junction with the corner post. The vestibule corner post is ⅛ in. thick, pressed to the proper contour and secured to the buffer beam extensions at the bottom, and to the side plate and vestibule end plate at the top. The vestibule end plate is a 3½ in. x 3½ in. x ¼ in. angle formed to proper contour and is riveted to the vestibule diaphragm posts above their connection to the diagonal braces.

It will be seen that this vestibule construction is designed to offer great resistance to end shocks and that no provision has been necessary for carrying the weight of the platform or the vestibule from any of the roof members since the steel casting in the underframe is amply sufficient to carry this weight. The end framing of the body, however, is even more massive and should the vestibule collapse, it would be practically impossible for another car to enter the car body proper.

Patent leveled plate, ⅛ in. thick below the belt rail and 3/32 in. thick above, is used for the outside sheathing. The end sheathing part is also 3/32 in. thick of the same plate, and the vestibule has ⅛ in. sheathing. On the interior the finish is of steel except as noted above. It was furnished by Hale & Kilburn. The floor is of Flexolith, 1⅛ in. thick, laid on ⅝ in. galvanized Chanarch of No. 22 gage. The latter was furnished by the Acme Supply Company. It will be noted that the Chanarch is carried through to the side sheathing between the posts and that the flooring is also continued, a joint being made, however, at the floor cove molding on the inside of the post. This arrangement prevents the entrance of cold air in the space between the posts and back of the inside finish.

One of the most interesting features of the car is the arrangement of the insulation, and in the cross sections it will be seen that adjacent to the inside finish at all points there is a ½ in. sheet of Resisto, or H. W. Johns-Manville Company "Nycinsul" insulation, and on the inner face of the outer sheets there is a ¼ in. Resisto sheet. The latter is brought inward around the posts and other members, and joins either the inner insulation or the wooden fastening strip applied for securing the inside finish. This insulation is secured to the plates by fasteners spot welded in place. At no point is there a continuous metallic connection between the inside and outside of the car. All open spaces between the framing, where there might be a possibility of circulation of cold air, are carefully filled with wood blocks or otherwise.

The cars are mounted on the standard six-wheel trucks of the New York Central Lines, set at 54 ft. centers. They have an 11 ft. wheel base. Some of the specialties employed are as follows: Steel doors, Hale & Kilburn. The body end doors close against a piece of solid rubber ½ in. square, and are also fitted with metallic weather strips. Trap doors and window fixtures, Tuco and Edwards; vestibule curtain, Acme Supply Company; draft gear and buffer, Miner Draft Gear Company; couplers, Tower; brakes, Westinghouse PC equipment with 16 in. service and 16 in. emergency cylinders; heating system, Ward Equipment Company; lighting, Gould axle system; seats, Hale & Kilburn walkover type; lock nuts, Columbia.

THE ELECTRO-PNEUMATIC BRAKE

At the January meeting of the New York Railroad Club, N. A. Campbell read a paper on the electro-pneumatic brake, stating that this type of brake is so arranged that under usual conditions the pneumatic apparatus is operated electrically, but if the electrical apparatus should become inoperative from any cause, that part of the equipment controlled by air pressure is not affected and the pneumatic operation will take place as usual.

There are several systems of operating air brakes electrically, some of which have been in successful operation for a number of years, principally on electric railroads operating multiple unit trains. In the system described magnet valves are employed to make local brake pipe reductions. It is believed that this system is the most applicable to steam railroad service, as it can be used in connection with the standard car and locomotive equipments now in use, and will not interfere with interchange. It is also applicable to multiple unit electric train service with substantially the same apparatus.

The standard automatic brake valve is used and the positions for electric operation are the same as those for pneumatic operation. Each of the various positions of the brake valve for controlling the air pressure throughout the air brake system has a corresponding position on the electric controller. The controller is connected to a series of wires passing throughout the length of the train.

There are three magnet valves on each car, viz.: the application, release and emergency magnet valves. They are attached to one bracket to which the pipe connections are also attached, so that a magnet valve can be removed without disconnecting any pipes. In the normal position the application and emergency magnet valves are closed and when energized, are opened. The normal position of the release magnet valve is open and it is closed when energized.

To make a service application of the brakes, the brake valve is placed in the service application position. In this position the application magnet valves are energized, which causes them to open and reduce the brake pipe pressure simultaneously on each car. The triple valves now operate in the usual manner, actuated by the differential in the auxiliary reservoir and brake pipe pressures, and permit auxiliary reservoir air to pass to the brake cylinders and apply the brakes. As the brake pipe reductions are made simultaneously on each car, and the action of the magnet valves is instantaneous, there is no interval between the application of the first and last brake. When a sufficient brake pipe reduction has been made, the brake valve should be returned to lap position. The application magnet valves are now de-energized and are closed by the air pressure, assisted by a spring, and the release magnet valves are energized. When the brake pipe reduction ceases, the triple valves move to lap position and prevent further flow of air from the auxiliary reservoirs to the brake cylinders, as though operated without the use of any electrical apparatus. The brakes can be applied with as many graduations as may be desired, and more uniformly than is possible without the use of the electrical apparatus, until full service braking pressure has been obtained.

As the application magnet valves reduce the brake pipe pressure at the same rate that the equalizing reservoir pressure is being reduced by the brake valve, the brake pipe reduction is made more rapidly than is possible with the automatic air brake, and the brakes are applied more promptly, resulting in a shorter service stop. For the same reason, the brakes are applied on a train of any length as rapidly as on a single car, also no electrical apparatus other than the generator and controller need be applied to the locomotive, because the brake pipe reduction made by the application magnet valves on the cars is sufficient to actuate the locomotive equipment.

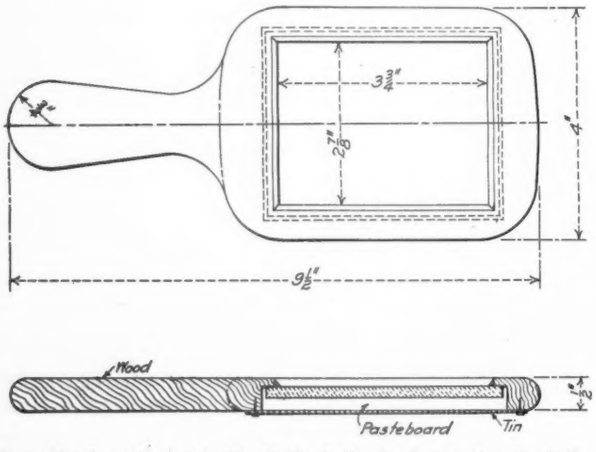
As the equalizing reservoir of the brake valve is always charged, as when the brakes are operated pneumatically, and its pressure reduced as usual when the valve is in service position, should

the current be interrupted and the application magnet valves fail to reduce the brake pipe pressure, the brake pipe exhaust will at once open and the ordinary pneumatic application will be obtained. Should one or more application magnet valves in any part of the train become defective and the brake pipe pressure be reduced slower than that in the equalizing reservoir, the equalizing piston will be raised by the higher pressure in the brake pipe and promptly assist in making the proper rate of brake pipe reduction. As this operation is entirely automatic and insures at all times a positive action of the brakes either electrically or pneumatically, on all cars in the train, it will cause no confusion on the part of the operator and he need not know whether the electric current is available or not. When the application has been made as heavy as the circumstances require, the brake valve handle can be placed in holding position; when this is done the release magnet valves are energized and are closed. Air is now being admitted to the brake pipe from the main reservoir at the same rate as in running position. The triple valves will move to release and charging position and the auxiliary reservoirs will be recharged so that the maximum braking pressure will be quickly available for either a service or emergency application. The brake cylinder pressure will be retained until the brake valve handle is moved to running position, when the release magnet valves will be de-energized and will open, allowing the brake cylinder pressure to escape to the atmosphere.

If it is not desirable to allow all the brake cylinder pressure to escape and entirely release the brakes, the brake valve handle can be returned to holding position, when the release magnet valves will again be energized and closed. The brakes can be graduated off to any extent desired and the brake cylinder pressure on each car will be uniformly reduced, thus avoiding any shocks that would be produced by unequal reduction of brake cylinder pressure and braking power. When an emergency application is necessary the brake valve handle is placed in the emergency position. The emergency magnet valves will be energized and will open, causing an instantaneous and heavy brake pipe reduction on each car sufficient to cause all triple valves to move to the emergency position. The maximum brake cylinder pressure is obtained on all cars in approximately the same time.

MIRROR FOR INSPECTING ARCH BARS

Defects are as liable to develop on the inside of the arch bars of freight car and tender trucks as on the outside, and it is practically impossible to discover them by the ordinary



Mirror Used on the Louisville & Nashville for Inspecting Arch Bars.

method of inspection. On the Louisville & Nashville the car inspectors have been provided with a small hand mirror of a shape and size shown in the illustration; by holding it on the inside of the bar any crack or other defect can be readily discovered.

Astonishing results have followed the introduction of these mirrors. They were put in use at one or two terminals on July 1, 1912, and all other inspection points on September 24. From July 1 to November 30, 1912, a total of 1,488 defective arch bars were detected in this manner. It is reasonable to assume that most, if not all, of these defects would have been overlooked without the aid of the mirror. Thirty-four broken bars were discovered in this way in two months at one terminal; forty-two at another in one month, and seventy-six at another in ten days.

TRUCK EQUALIZER DESIGN

BY L. V. CURRAN

In designing equalizers, forces other than those caused by the car weight alone should be considered, although it is believed that this is not commonly done. The part that the air brakes play in the equalizer load distribution is by no means negligible, and causes a very unequal distribution of the load, the magnitude of which depends on several quantities. The most important of these are the train velocity, the braking force, the angle of the shoe hanger, the location of the hanger connection to the frame, the equalizer proportions, and the car weight. While a large factor of safety often prevents the consequences of faulty design, a true conception of all conditions affecting the load capacity of the equalizer should be sought for.

Referring to Fig. 1, a brake load delivered to the wheel horizontally through the shoe will exert a component force through

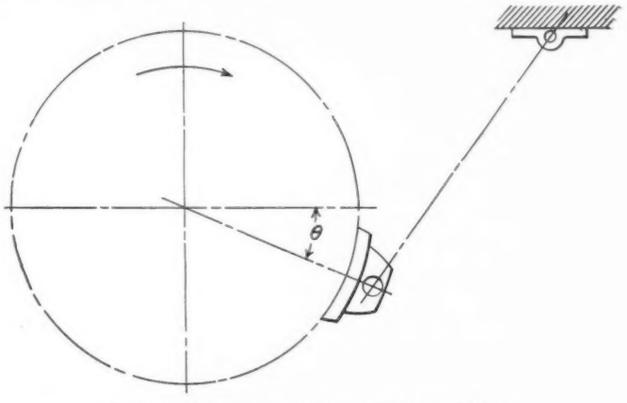


Fig. 1—Diagram of Brake Shoe and Wheel.

the center equal to L cos., Θ, in which L is the brake load on the wheels.

If f is the coefficient of friction at the train velocity investigated, the tangential wheel load at the brake shoe will be $= f\ L$ cos. Θ.

The vertical component of this transmitted through the brake hanger to the truck frame, and finally to the equalizers, will therefore be equal to: $f\ L \cos.^2\Theta = P$.

Take first the case of a four-wheel truck, and assume the usual braking load, 80 per cent. of the light weight of the car and 1.7 times this amount for an emergency application of the brakes. Also assume .25 for f at 60 miles an hour. For an emergency application of the brakes:

$$P = .0425\ w \cos.^2\Theta$$

in which w is the light weight of the car.

From the direction of wheel rotation it is evident that the force P will act down with the car weight on one equalizer spring cap, and up against the car weight at the other spring cap. If the brake hanger connections to the frame are practically the same distance from the center as the spring caps, as is usually the case

with inside hung brakes, the loads on the two springs will be: $\frac{W}{8} + P$ and $\frac{W}{8} - P$ respectively, W being the loaded weight of the car less the weights of the truck parts below the coil springs.

If the brake hanger connections are some distance from the spring cap horizontally on the length of the truck frame the effect of this lever arm will have to be considered. By taking the sum of the moments around each spring cap separately the correct spring load will be easily obtained.

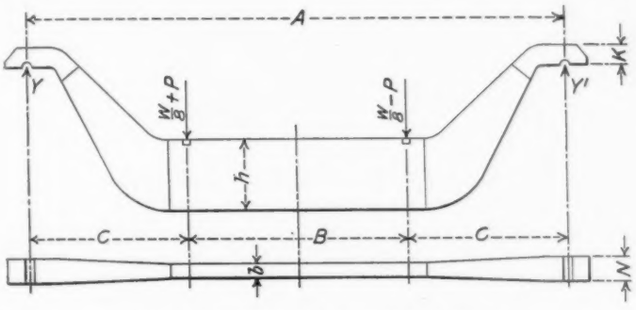


Fig. 2—Equalizer for Four-Wheel Truck.

Reference to Fig. 2 will show that the greater reaction or pressure is at Y and that it has the following value:

$$Y = \left(\frac{W}{8} + P\right)\left(\frac{B + C}{A}\right) + \left(\frac{W}{8} - P\right)\left(\frac{C}{A}\right)$$

$$= \frac{B\,W + 8\,B\,P + 2\,C\,W}{8\,A} = \frac{A\,W + 8\,B\,P}{8\,A}$$

The maximum bending moment, M, is then

$$M = Y\,C = \frac{C\,(A\,W + 8\,B\,P)}{8\,A}$$

Assuming that b is determined and that a fibre stress of 16,000 pounds per square inch is permitted for safe loading, the required depth of the equalizer, h, is obtained as follows:

$$\frac{16{,}000 \times I}{c} = \frac{C\,(A\,W + 8\,B\,P)}{8\,A}$$

$$I = \frac{1}{12}\,b\,h^3 \text{ and } c = \frac{h}{2}$$

$$\text{Therefore } h = \sqrt{\frac{C\,(A\,W + 8\,B\,P)}{21{,}336\,A\,b}}$$

In the case of six-wheel trucks, there are twelve brake shoes instead of eight, and P becomes:

$$\frac{8}{12} \times .0425\ w \cos.^2\Theta = .028\ w \cos.^2\Theta$$

The brake hangers are usually hung in the proportions shown

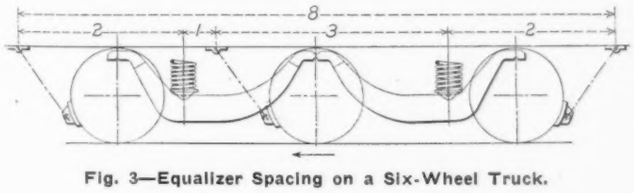


Fig. 3—Equalizer Spacing on a Six-Wheel Truck.

in Fig. 3, and when the truck travels in the direction indicated the spring loads on one equalizer are: $\frac{W}{8} - 1\frac{1}{4}\,P$, and on the other $\frac{W}{8} + 2\frac{1}{4}\,P$. The latter will govern the design.

The reactions at the ends of the equalizer when loaded, as shown in Fig. 4, are:

$$Y = \frac{2}{3}\left(\frac{W}{8} + \frac{11}{4}\,P\right) \text{ and } Y^1 = \frac{1}{3}\left(\frac{W}{8} + \frac{11}{4}\,P\right)$$

The maximum bending moment at the spring seat is:

$$M = \frac{Y\,A}{3} = \frac{A\,(W + 22\,P)}{36}$$

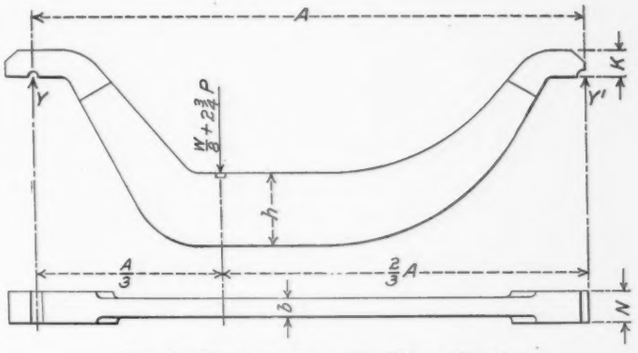


Fig. 4—Equalizer for a Six-Wheel Truck.

Then the required depth obtained as above and with the same fibre stress becomes

$$h = \sqrt{\frac{A\,(W + 22\,P)}{96{,}000\,b}}$$

For use in stress investigation the following transpositions are useful:

$$\text{Maximum fibre stress} = \frac{C\,(A\,W + 8\,B\,P)}{1.33\,h^2\,A\,b} \text{ for four wheel trucks}$$

$$\text{and} = \frac{A\,(W + 22\,P)}{6\,h^2\,b} \text{ for six wheel trucks.}$$

SPECIFICATIONS FOR POSTAL CAR LIGHTING

The post office department has issued revised specifications, dated December 28, 1912, for full postal cars, including the requirements for lighting. The lighting is to be done by either gas or electricity, wherever feasible. Mantles are to be used on gas lights where practicable, and fixtures, wiring, etc., are to conform to the railroad company's standards. Electrically lighted cars must have storage battery capacity sufficient to furnish for 12 hours, without any charging during that period, the intensity of illumination specified; while cars lighted by gas must have storage capacity sufficient for 36 hours. The details of the lighting specifications are as follows:

Location of Light Units.—The light units for illuminating the bag rack and storage portions of the car shall be located on the center line of the postal apartment. Direct lighting units shall be located at such uniform height that the shadow of the paper boxes is not cast on any bag rack label, nor higher than approximately 3 in. above the back rod of rack. In no case shall any light unit (except oil lamps, the lowest point of which may be 6 ft. 9 in. from the floor) be mounted at a height of less than 7 ft., measured from the floor to the lowest point of the light unit (spacing between adjacent units in the bag rack portion of the car shall not exceed 8 ft. 6 in. in case of any direct system of lighting, nor 14 ft. in case of any indirect system).

Light units for illumination of the letter cases shall be mounted at the same height from the floor as the units in the body of the car, and as far from the front of the face of the letter case as possible, without the body of the distributor throwing any shadow on his work. In standard construction, where the letter case table is 17 in. wide, the above distance is 20 in. Where the car construction does not permit the above distance to be employed, a lesser distance, but not less than 16 in. may be employed. Separation between adjacent letter case units shall be such as to provide an illumination intensity at all points within the requirements hereinafter specified.

If an indirect lighting system be employed, the provisions of

the above paragraph will be waived. In such case, the only requirements imposed for location of units of letter cases are those involved in providing for sufficient vertical and horizontal illumination intensities to meet the provisions of these specifications as hereinafter stated, all units in the car burning. For the purpose of these specifications an indirect system is here defined as any system in which at least 85 per cent. of the horizontal illumination on the 46-in. plane of utilization is received, either directly or indirectly, by reflection of the light from the deck of the car.

In the case of incandescent electric or mantle gas lamps, the design of light unit, except letter case units, shall be such that no portion of the bare lamp filament or the bare mantle is visible to the eye when the unit is observed at an angle of 70 deg. or greater from the nadir. (In general, light units are preferred which emit no light or only a small amount of light between the angles of 50 deg. and 100 deg. from the nadir.) The control of the lights in the postal apartment shall be independent of any other lights in the car, and the letter case units shall be controlled independently of any other light units in the postal apartment.

Initial Illumination Values.—All horizontal illumination values shall be taken on a plane 46 in. above the floor line. Vertical illumination values shall be taken on the vertical plane on the face of letter case as specified below. New lighting installations shall be such as to give initial illumination values in foot candles within the following limits:

Location.	Minimum.	Maximum.
Bag-rack portion:		
Center of car, horizontal	4.70	10.00
Mouth of bags, illumination measured 18 in. from side of car, horizontal	2.50	10.00
Letter cases:		
Over table, horizontal	4.70	16.00
Face of case, vertical	2.08	16.00
Storage portion, not behind obstruction, horizontal, measured not less than 18 in. from side or end of car.	2.50	10.00

Illumination requirements at letter cases as above specified shall be entirely fulfilled by letter case units, other units in the car not burning; but letter case units may be considered as contributing to the specified illumination values for the body of the car.

If globes or reflectors of opal glass, rough crystal glass, prismatic glass, or aluminized metal, and those giving similar results (excluding heavy density opal with glazed reflecting surface, mirror glass, porcelain enameled metal and those giving similar results) be employed, the minimum values specified in the above table may be reduced 20 per cent. and the maximum values increased 20 per cent.

Above illumination values are based on an allowance of 40 per cent. for depreciation in service. Less efficient maintenance must be compensated for by increased initial installation.

If an indirect lighting system be employed, the minimum and maximum values in the above table may be respectively decreased and increased 40 per cent. in the bag rack and storage portions of the car, and 25 per cent. at the letter case locations specified in the above table.

Service Illumination Values.—While the car is in active service the lighting installation shall be maintained at all times to give illumination values (in foot-candles) not less than the following minimum values:

Location.	Minimum.
Bag-rack portion:	
Center of car, horizontal	2.80
Mouth of bags, illumination measured 18 in. from side of car, horizontal	1.50
Letter cases:	
Over table, horizontal	2.80
Face of case, vertical	1.25
Storage portion, not behind obstructions, horizontal, measured not less than 18 in. from sides or ends of car	1.50

Illumination requirements at letter cases as above specified shall be entirely fulfilled by letter case units, other units in the car not burning; but letter case units may be considered as contributing to the specified illumination values for the body of the car.

If globes or reflectors of opal glass, rough crystal glass, prismatic glass, aluminized metal, and those giving similar results (excluding heavy density opal with glazed reflecting surface, mirrored glass, porcelain enameled metal, and those giving similar results) be employed, the minimum values specified in the above table may be reduced 20 per cent.

If an indirect lighting system be employed the minimum values in the above table may be decreased 40 per cent. in the bag rack and storage portions of the car, and 25 per cent. at the letter case locations specified in the above table.

A light failure is defined as the condition where for a period exceeding 30 minutes the primary lighting system fails to give sufficient illumination to permit distribution of mail matter to be continued. It will be considered that whenever the lamp voltage falls below 80 per cent. of the normal operating lamp voltage such a condition of light failure has been reached.

A car movement is defined as the use of a postal car by a crew of postal clerks over the length of their run in one direction. Where a car covers more than the run of one crew, each separate run shall be considered a car movement.

The percentage of failure of the lighting system is defined as the ratio of the total number of failures to the total number of car movements of each primary system of lighting (gas and electrically lighted cars to be considered separately) on each railway system. The determination of percentage of failure shall be based on the operating performance of each car for the preceding twelve months period. Only such failures as are promptly reported by the railway mail service to the operating railroad shall be considered in computing the percentage of failure.

Emergency Lighting.—If the percentage of failure of the primary system of electric or gas lighting does not exceed 1 per cent., candle lamps will be accepted as a suitable emergency light. If the percentage of failure of the primary system of gas or electric lighting exceeds 1 per cent. and is not greater than 4 per cent., an emergency system of suitable oil lamps, gas or electric lights, maintained by independent storage capacity, may be required. Such emergency system must provide illumination values not less than 50 per cent. of the minimum operating illumination values specified above for the primary system, with the exception of letter cases and center line of car through bag rack portion where the illumination shall not be less than 60 per cent. If the percentage of failure of the primary system of electric or gas lighting exceeds 4 per cent., a new installation or a second complete primary system of lighting will be required on cars so failing.

Motor Sleeping Cars for Australia.—It is reported that two motor cars will be used on the Transcontinental Line in Australia so arranged that the back of the front seat and the cushions in each car may be used for sleeping accommodation.

Coach Cleaning on the Pennsylvania.—In the Pennsylvania's yard at Sunnyside, Long Island, over eleven thousand cars are cleaned every month, and only the cars on long distance trains, and dining cars are handled here. Before the completion of the tunnel system connecting Long Island with Manhattan and New Jersey, all trains went to the yard in Jersey City, where over 18,000 cars a month were cleaned. The problem of exterior cleaning is being studied very carefully by the Pennsylvania. Experiments are being made with different solutions for this work, the principal ingredients of all being oil and soap. Every solution is tried out for a period of three years and each time a car is cleaned it is recorded. When the car goes to the shops at Altoona to be overhauled data is compiled from these records to be used in determining which solution is the most effective and economical.

NEW DEVICES

HORIZONTAL DRILLING AND BORING MACHINE

A new type of horizontal drilling and boring machine has been developed by the Pawling & Harnischfeger Company, Milwaukee, Wis., that has found extensive application in railway shops. It is designated as No. 8, and is a development of the No. 3 type. The machine consists of a fixed vertical head on which the tool head may be raised or lowered over a range of 6 ft. 10 in., and a table mounted on four small wheels running on short rails imbedded in concrete. The machine will operate over a surface area of 60 sq. ft., and will drill and tap holes up to 3 in. in diameter. It will also operate boring bars over the same area.

Special attention has been given to a wide range of spindle speeds and for this purpose a 7½ h. p. variable speed motor of 750 to 1,700 r. p. m. is provided with four mechanical speed changes, which, with 20 speed changes in the controller, gives a total of 80 different speeds graduated from 10 r. p. m. to 475 r. p. m. There are eight feeds for each spindle speed ranging from 0.008 in. to 0.148 in. per revolution of the spindle. The diameter of the spindle is 3¼ in., it is provided with a No. 6 Morse taper and has a range of horizontal feed of 30 in.

The motor is located on top of the column and drives a vertical shaft through a pair of bevel gears. From this vertical shaft the motion is transmitted to a horizontal shaft upon which the reversing clutch is located. From this point the motion is transmitted to the first speed clutch, which is of the same design as the reversing clutch, and thence to the second speed change which is provided with a simple jaw clutch. The feed is taken from the spindle through four feed change gears and a pair of back gears. The spindle can also be fed by hand. All the friction clutches and high speed gears are enclosed in an oil and dust tight casing, and are lubricated by the splash oil system. All the gears are cut from cast steel blanks and the pinions are of high carbon steel. The spindle also is of high carbon steel, horizontal thrust being taken up by a ball bearing. The carriage weighs 3,500 lbs., and may be moved up and down either by hand or by power. It is balanced by a counterweight, sliding on the back of the column, which also weighs 3,500 lbs.

The controller is attached to the top of the column and is provided with a vertical shaft extending down to the carriage and a hand wheel traveling with the carriage. All levers and hand wheels are located so that the operator may reach them without leaving his work. Upon completion of a tapping operation, the operator may reverse the spindle, throw in the high speed

Horizontal Drilling and Boring Machine for Heavy Work.

gear by means of the friction clutch, and thus withdraw the tap. The table is 8 ft. long, 6 ft. wide, 18¾ in. high, and weighs 8,200 lbs. It is moved on the rails by a lever engaging in a notched wheel. After locating the work it is securely clamped to the rails. The following are tests with 3 in. and 1 in. drills:

	Cast Iron.	Medium Steel—.15 to .20 per cent. carbon.	
Size of drill	3 in.	3 in.	1 in.
Make of drill	Celfor	Celfor	.....
Revolutions per minute	124	88	290
Peripheral speed (in feet)	98	69	75.8
Feed per minute (in inches)	2.23	1.56	3.48
Feed per revolution of spindle	0.018	0.018	0.012
Time to drill hole 4 in. deep	1 min. 45 sec.	2 min. 33 sec.	1 min. 28 sec.
Total amperes	40	44 to 56	28
Amperes to run machine	5	5	5
Net amperes to drill	35	39 to 51	23
Drill lubrication	None	None	None

The No. 3 type of this machine has been in use in the Milwaukee shops of the Chicago, Milwaukee & St. Paul for seven years, and the parts noted below are drilled or bored on it. Cylinders are drilled or tapped, the holes being faced, where necessary. The steam pipe ring joints and relief valve ring joint are also faced. The hole in the spring lug on the reverse shaft is drilled easily and quickly, the shaft being clamped on the table with V blocks; the time required to do this job is about one-half that required on a vertical drill.

Steam chests for slide valve locomotives have the stuffing box and relief valve holes bored and faced; also the stud holes for glands are drilled. The steam chest is clamped on the table and the only movement necessary is to move the table to bring the holes in line with the bar. This chest formerly was bored with a horizontal boring bar and was then taken to a drill press to have the stud holes drilled. It has also been bored on a vertical boring mill, but requires an angle plate to bolt the chest to, all of which is eliminated on this machine.

It is necessary when a driver wheel spoke is cracked to drill it before it can be thermited. The wheel is taken to this machine without removing the axle, and the holes are drilled quickly and easily. Formerly it was necessary to drill the holes with an air motor, which required about three times the time it now takes. Steam pipes are drilled and the joints faced, the pipes being clamped on the table. When this job is done on a vertical drill a pit is required and it is a difficult job to clamp the pipes and level them up. Tee heads and collector castings for superheaters are easily drilled, as they will lie flat on the table where the work is directly in front of the operator.

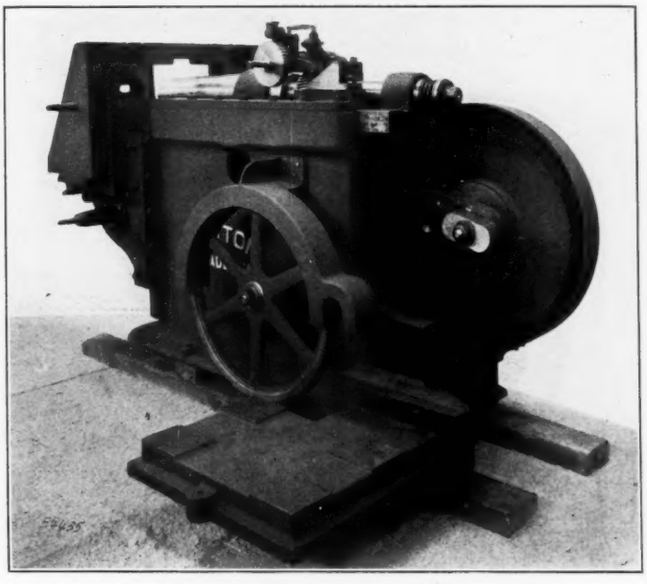
Air pump brackets and link supports are drilled, it being a simple job to clamp such work on the table of the machine. When done on a vertical drill it is difficult to set up these castings. Cast steel bumper beams are also drilled quicker and with less handling on this machine than on vertical drills.

The main features of this drill that make it specially adapted to locomotive work are the horizontal drilling arrangement, which allows of the work being placed in a vertical position directly in front of the operator, and the movable table.

Indian Railway Policy.—The present policy of improving existing lines prior to making new extensions is justified by past experience. Opening a settled and thickly populated country, such as India by railways, is a very different enterprise to opening new countries. In the latter, population and cultivation follow the railway, and traffic grows slowly with the development of the country, so that the resources of the line are not suddenly taxed, but grow gradually with the traffic requirements. It is different in India, where the country pierced is often rich and railway facilities are taken advantage of fully from the opening of the line. Much of the complaints about insufficient arrangements for traffic are due to this feature. The call on the new lines is so great that the older lines even become congested with the rapidly increased traffic. In new countries this would not happen; growth of traffic would be more gradual.

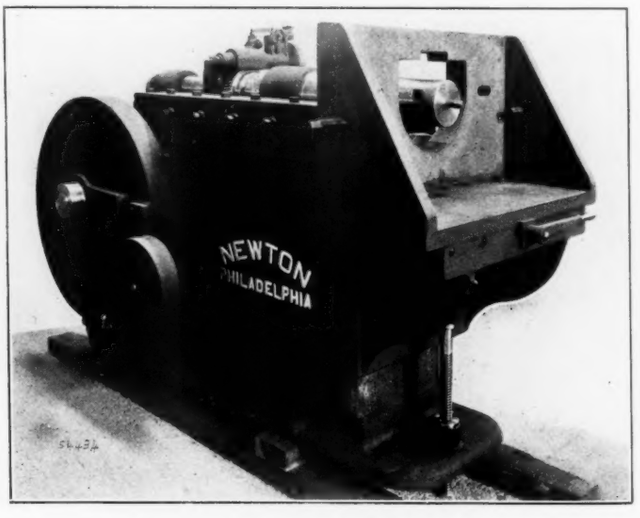
SHAPER FOR DRIVING BOXES

A powerful machine designed principally for rapid work in connection with heavy cuts on the crown brass fit of steel driving boxes is shown in the illustrations. It is a push stroke shaper having a circular feed and is designed for cutting to a diameter of 15 in. with a 15 in. stroke. The boxes are clamped to the face of a substantial angle plate on the front of the machine,



View Showing Circular Feeding Mechanism.

which is provided with adjustable screw stops on either side for steadying. The angle plate in connection with the piece below has adjustments in both directions and the box can be quickly centered on the cutter bar. The machine is driven by a 10 h. p. motor which carries a pinion that engages a large driving spur gear which in turn transmits the motion to a large plate gear which operates the ram through a Whitworth drive, giving a



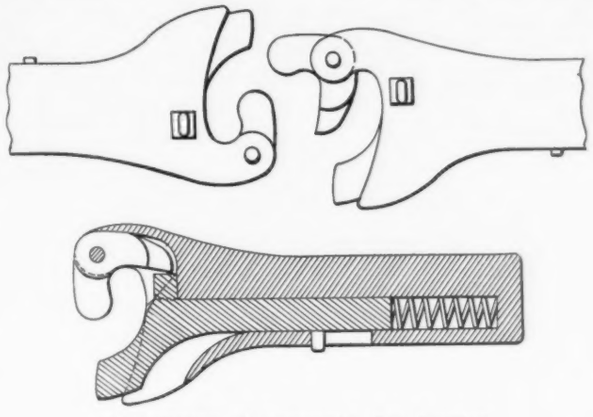
Heavy Duty Shaper for Driving Boxes.

quick return stroke. The machine has a positive 15 in. stroke with clearance to permit the feeding mechanism to operate. The cutter bar is a solid forging having double tapered bearings in the front of the ram and is provided with a spring tool relief at the rear. The circular feeding mechanism is simple and operates through the medium of a ratchet wheel, the amount of

the movement being controlled by the location of an adjustable incline which the end of the bell crank, carrying the dog, strikes at the completion of the return stroke. This shaper is of exceptionally heavy construction throughout and is simple in its arrangement and operation. It is designed and built by the Newton Machine Tool Works of Philadelphia, Pa.

A NEW DESIGN OF CAR COUPLER

The principal feature of the Stark coupler is the plunger which is shown in the sectional view of the illustration. This plunger slides in a socket which is cast in the coupler shank, and is cushioned by a spring at the bottom. A dowell in a slot at the side of the coupler shank prevents the plunger from moving out too far. In coupling, the knuckle of the opposing coupler forces this plunger in against the spring, slides by it and engages with the other knuckle. The plunger is then forced out by the action of the spring and prevents the knuckle disengaging until released



New Design of Automatic Car Coupler.

by the movement of the locking pin. The knuckle locking pin has a corrugated surface on the side next the plunger, which has corresponding corrugations at this point. In pulling, the tongue of the knuckle forces the locking pin against the plunger and the corrugations prevent the latter from moving and thus allowing the couplers to disengage.

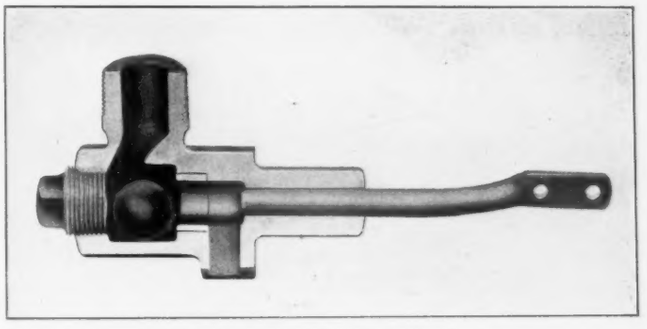
It is claimed for this coupler that it is automatic under any coupling conditions, with knuckles either open or closed and on either straight or curved track. It is patented by C. H. Stark, Strasburg, Virginia.

AUTOMATIC CYLINDER COCK

Cylinder cocks require frequent attention to keep them tight and in operating order. The failure or inability of the engineman to open the cocks before starting has been the cause of many broken cylinders and cylinder heads. Even more serious are the possibilities of the unexpected starting of a locomotive having a leaky or but partially closed throttle, which, unless the cylinder cocks are left open, is almost sure to occur.

To correct these troubles so far as it is possible to do so by design and construction, the Watertown Specialty Company, Watertown, N. Y., has developed an automatic cylinder cock for locomotives which operates in a manner similar to certain designs of gage glass fittings, and employs a bronze ball which is held against its seat by the pressure of the steam inside the cylinder, but falls to the bottom of a cavity and opens a passage to the atmosphere when the pressure is released. This type of cock opens as soon as the throttle is closed and remains open until steam is again admitted to the cylinder, and will allow no collection of water in the cylinder previous to the admission of steam. It is remarkably simple and should require the minimum attention to maintain in operating condition. Arrangements are made for unseating the valve when there is pressure in the cylinders through the medium of the usual gear. The arrangement of the plunger for forcing the ball back is clearly shown in the illustration.

This valve has a gray iron body which fits close to the cylinder and gives an increased clearance as compared with the usual design. The valve seat is bushed with a bronze bearing and the

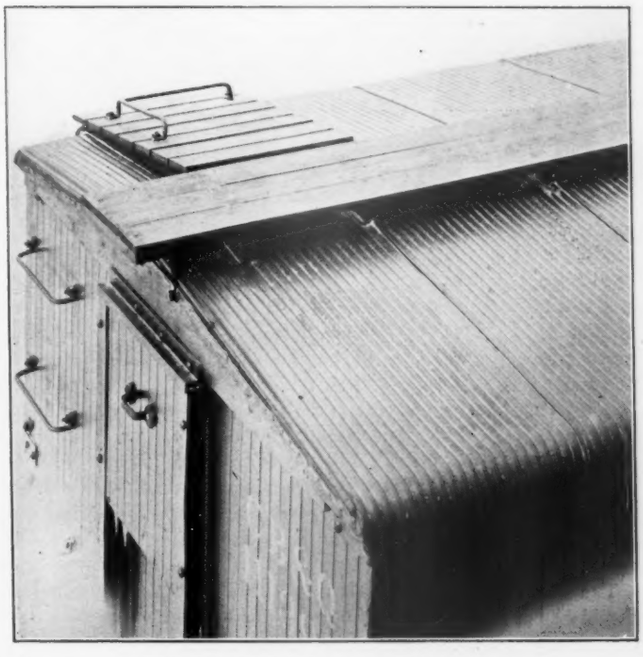


Watertown Automatic Cylinder Cock.

ball is also of bronze accurately ground to shape. The screw plug at the end of the ball chamber allows the valve to be inspected or cleaned. It is said that cocks taken from switch engines that have been in use for three years show practically no wear on the ball or its seat. This cylinder cock is distributed by the Diamond Specialty Company, Harrison building, Philadelphia, Pa.

PRIES OUTSIDE METAL CAR ROOF

The qualities most desired in a car roof are that it should be leakage proof, durable, simple in construction, cheap to maintain and that it will not add excessively to the weight of the car. These features have been considered in the Pries corrugated steel



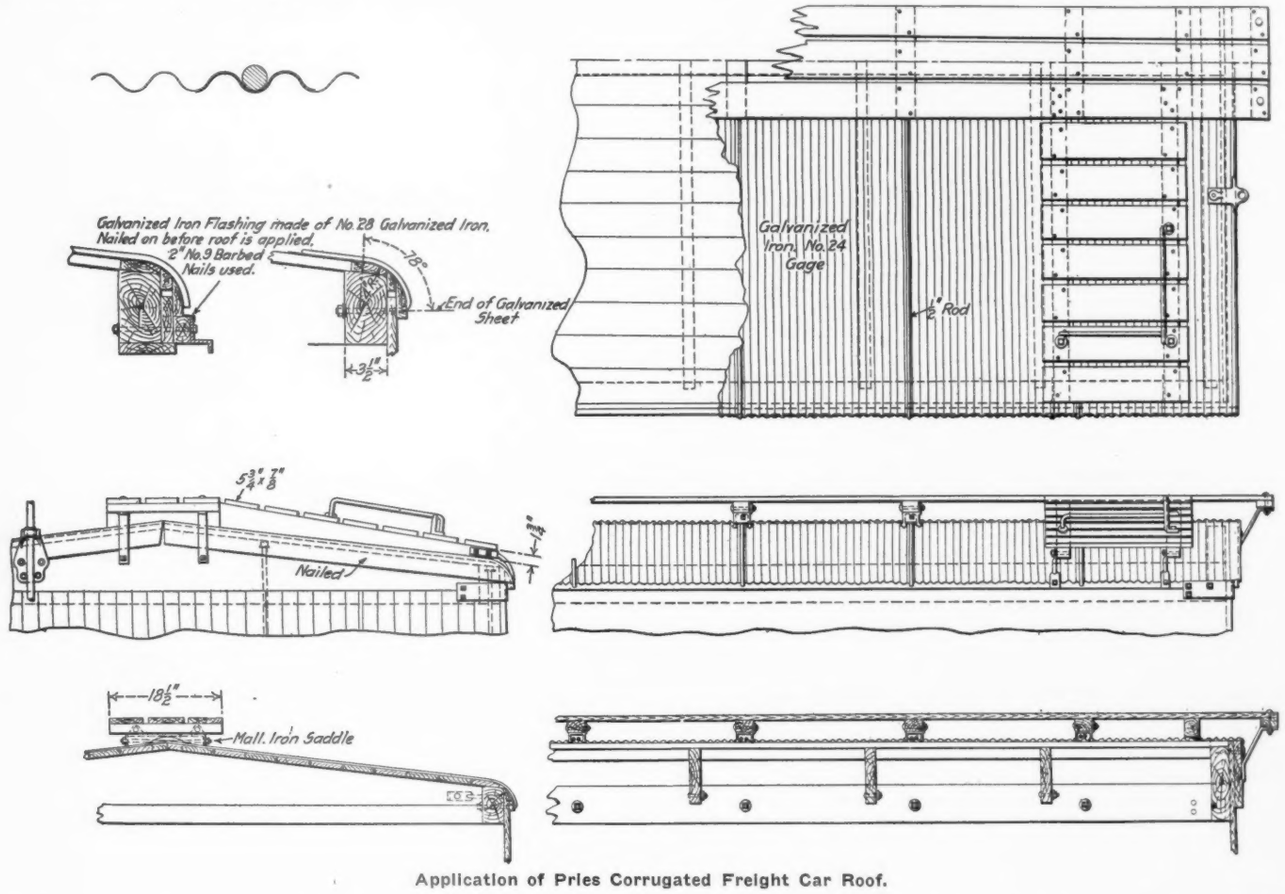
Pries Corrugated Roof for Freight Cars.

freight car roof, illustrated herewith, which is manufactured and sold by the Union Railway Equipment Company, McCormick building, Chicago. The roof is composed of three parts, viz., the sheets, tie rods and malleable iron running board saddles. The sheets, of No. 24 gage corrugated, galvanized steel, 30 in.

wide, are continuous over the full width of the car and are laid over a wooden roofing. They are lapped two and one-half corrugations in application and are held in position by ½-in. tie rods which are secured to the side plate at one end and to the metal running board saddle at the other. The rods follow the groove at each lap of the sheets and hold them securely, making the joint water tight. There are no perforations of any sort in the sheets except at the edges of the end sheets, which are tacked to the end plates for a finish. The sheets are manufactured with a steel roll to prevent any fracture in the metal and are then galvanized, being supplied to the railroad with the radius at the eaves, and formed at the peak of the roof, as illustrated, ready for application.

The desired flexibility is obtained by the manner of lapping the sheets and by the corrugations. This simple construction eliminates the necessity of a multiplicity of small parts, such as caps or clips, which provide pockets for rust. All the sheets are made to a uniform standard width of 30 in. and are suitable for any length of car, as the end sheets may be lapped over the adjacent sheets a sufficient amount to overcome any variation without cutting the sheets. This roof is also claimed to be well adapted to use on old cars by trimming the roof boards flush with the side plates, applying a bevel edged facia, removing the old running board and laying the metal sheets over the old roof, securing them with the rods as shown in the drawing.

The running board is applied to wooden blocks with screws, the blocks being bolted to the metal saddles, which in turn are held firmly in position by the tie rods. The transverse running boards on the ends of the car are fastened with screws to wooden stringers, which are fastened to the running board saddles with bolts and at the eaves of the car with curved anchor bolts secured by ⅝-in. carriage bolts through the side plate below the edge of the sheets. The simple construction of the roof makes an easy application, requiring no expert mechanics, and any sheet may be easily renewed by releasing the tie rods over that particular sheet, as there is sufficient space underneath the running board to slide the sheets through.

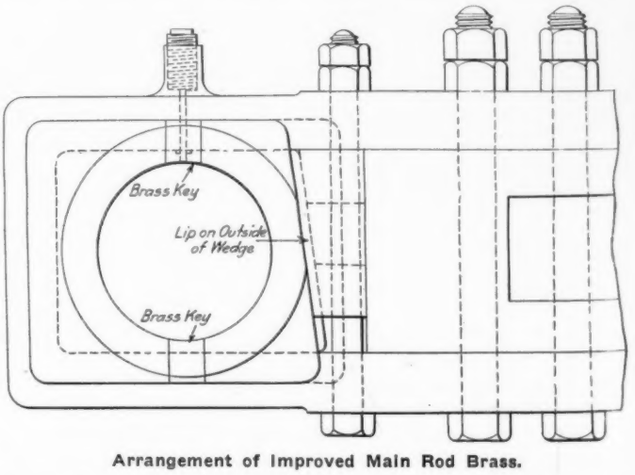


Application of Pries Corrugated Freight Car Roof.

IMPROVED ROD BRASS

BY J. E. OSMER,
Master Mechanic, Chicago & North Western, Boone, Ia.

Several improvements have been made in the rod brass which was illustrated and described on page 26 of the January, 1912, issue of the *American Engineer,* and it is now so arranged that the brass may be reduced, the rod lengthened or shortened, or the wedge key lined down without removing any of the rod bolts. As shown in the illustration, this has been accomplished

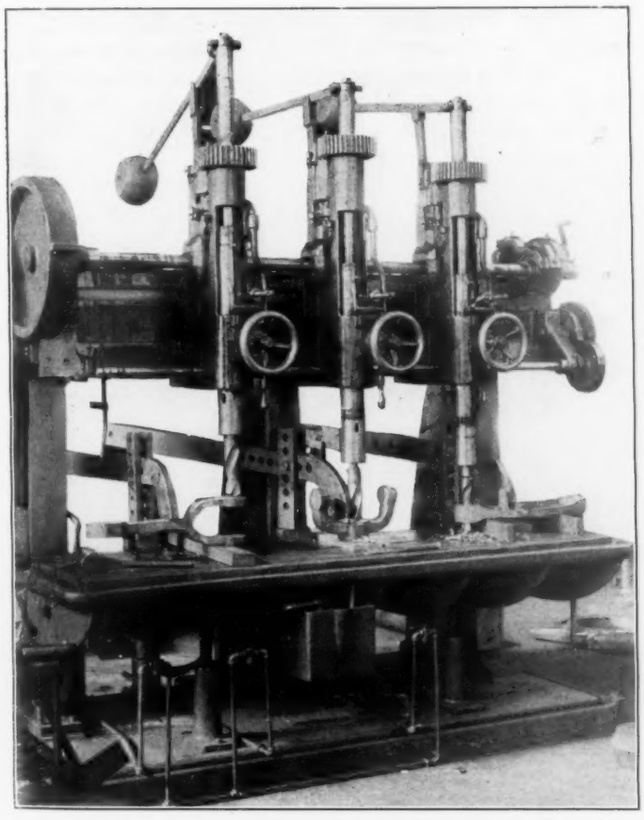


Arrangement of Improved Main Rod Brass.

by the elimination of the flange at the front of the brass on the outside of the rod. In this way the wedge can be adjusted or removed, the liners can be inserted, etc., without removing the brass. This, taken in connection with the use of a brass key at the top and bottom between the two halves of the brass, which on removal of the nut and washer and return crank, if the Walschaert valve gear is used, can be taken out and planed off sufficient to permit the brass to be closed the desired amount, allows all usual adjustments to be made without removing the rod bolts. This construction has demonstrated its usefulness in service and has resulted in a decided reduction in the time and cost of maintaining main rod brasses.

PNEUMATIC DRILL PRESS CLAMPS

The illustration shows an application of the Thomson pneumatic clamps to a 3-spindle Foote-Burt drilling machine. The capacity of the machine has been greatly increased by their use. The application of the work is greatly facilitated and it is thus possible for the workman to keep the three spindles working most of the time. They clamp the work under the drill instantly, and are of simple construction, consisting of a small cylinder, located at the rear of the machine, which is connected to the shop air line. When the air is admitted by the valves shown



Thomson Pneumatic Clamps Applied to a 3-Spindle Foote-Burt Drill.

in front of the machine, which are placed in a convenient position for the operator, it forces a plunger against the clamping lever. This lever fulcrums in a yoke, easily fastened to any part of the table by T-bolts, and may be applied in almost any position.

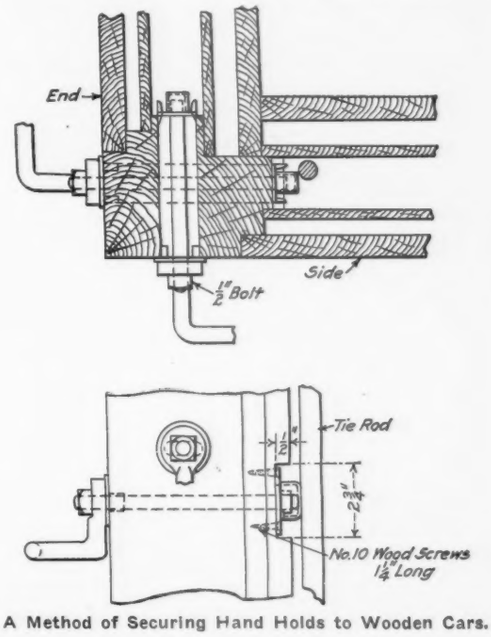
The clamps are also adapted to other makes of drill press and are in use on all such machines in the Beech Grove (Ind.) shops of the Cleveland, Cincinnati, Chicago & St. Louis, where the cost of drilling has been materially reduced by their use. They are made by the Thomson Pneumatic Tool Company, Indianapolis, Indiana.

DEVICE FOR SECURING HAND HOLDS

BY NICHOLAS C. THALHEIMER

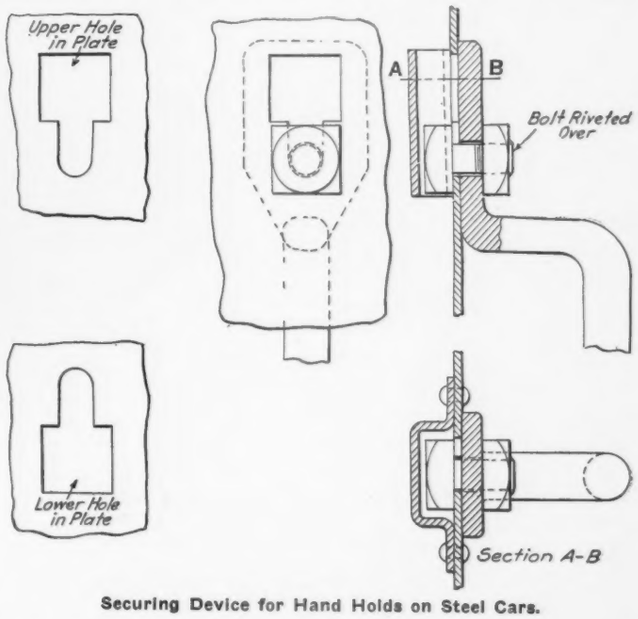
To meet the requirements of the Interstate Commerce Commission regarding safety appliances, without incurring any great expense, a device for securing hand holds and ladder rounds has been adopted on the Baltimore & Ohio for refrigerator cars and steel passenger train cars.

The device as applied to freight equipment cars consists of



A Method of Securing Hand Holds to Wooden Cars.

a malleable iron pocket secured to the back of a timber at the end of an elongated hole which passes through the timber. This pocket is so designed as to seat a T-head bolt when it is passed through the elongated hole and given a quarter turn. A malleable iron washer is applied at the outer end of the hole in such a way as to keep the bolt from moving out of center.



Securing Device for Hand Holds on Steel Cars.

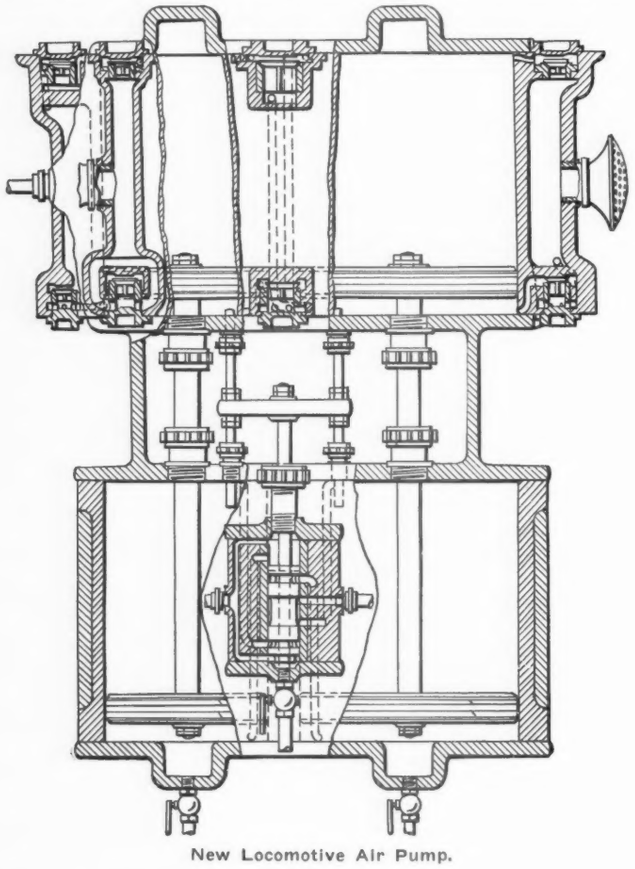
The ladder round or hand hold is then applied to the bolt and held in place by nuts. Its use on refrigerator cars avoids the necessity of removing the ice-boxes when applying ladders.

In the application of hand holes to steel passenger equipment

cars, a pressed steel plate or pocket is secured by rivets to the back of the corner post or side sheet, covering a slotted hole which is so shaped as to permit the entrance of a square headed bolt. This bolt when passed through the slotted hole, drops down a short distance and seats itself. The pocket prevents the bolt from turning when the nut is applied, and also avoids piercing the inside lining of the car. When applying a hand hold with this device, one of the holes for the bolt head is inverted, thus avoiding any possible chance of the hand hold disengaging. This device is patented.

COMPOUND LOCOMOTIVE AIR PUMP

Patents on a new design of locomotive air pump have been granted to F. Tuma, master mechanic of the Erie at East Buffalo, N. Y. This design has been prepared for the purpose of reducing the liability of failure and decreasing the steam consumption. The use of hollow pistons and tappet rods has been dispensed with and the design is such that if one side of the pump becomes disabled the other will continue to operate. The inventor claims that the pump will give 14.03 per cent. thermal efficiency and 95.06 machine efficiency with 200 lbs. steam pressure, and correspondingly lower efficiencies with the lower pressures. All four pistons move in the same direction at the same time. The steam valve is connected at its upper end to a V shaped casting, which in turn is secured to two rods passing through stuffing boxes into the different cylinders. These rods are of such a length that they will be struck by the pistons when near the end of their strokes and the valve will be reversed. It will be seen that if either half of the pump is inoperative the other pistons will continue to move the valve in the proper manner. The steam chest with its valve is located at the centre and between the two steam cylinders which are on the lower end of the pump. The arrangement of the passages and the method of operation will be clear by an inspection of the illustration. The two steam cylinders operate on the normal, full stroke compound principle, the steam admission being on the left hand side and the exhaust at the right of the valve chamber.



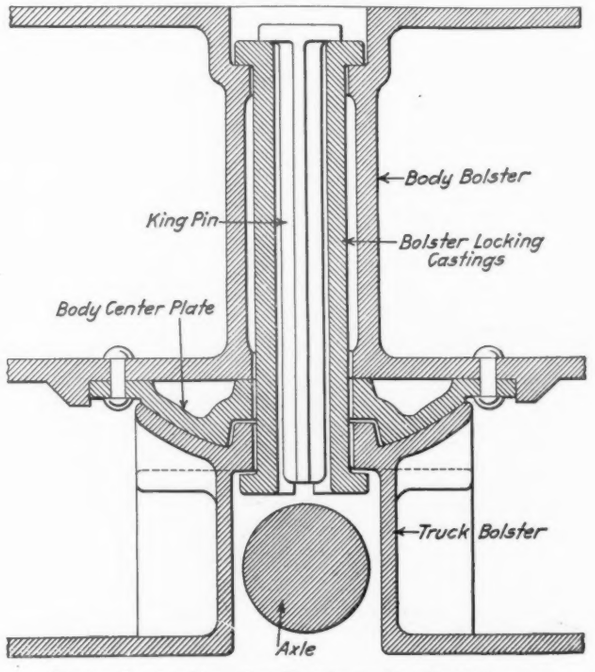
New Locomotive Air Pump.

At the air end of the pump provision is made for an atmospheric intake to both cylinders, and the only moving parts, outside of the pistons themselves, are a series of check valves which are entirely automatic in their operation and are held on their seats by gravity when there is no pressure in the system. The arrangement of the passages and check valves is such that the discharge from the low pressure cylinder enters the space at the opposite end of the high pressure cylinder, and when the pressure is low it also partially discharges to the main reservoir. When the reservoir pressure becomes greater than the pressure between the high and low pressure cylinders, this outlet directly from the low pressure cylinder to the reservoir is closed and the air discharged from the low pressure cylinder passes directly to the high pressure and assists in compressing the air on the opposite side of the high pressure piston. The inlet to the high pressure cylinder from the atmosphere is ready for operation and does operate whenever the differential pressures will permit it to open. It is expected that this pump will be able to maintain a pressure of 140 lbs. in the main reservoir with a steam pressure of 125 lbs.

CAR AND TRUCK LOCKING DEVICE

When the underframe of a passenger car rises above that of the next car in a collision, it generally results in the two cars telescoping. If the two underframes could be kept in line, they will absorb the shock and telescoping will be prevented.

A device has been developed on the Grand Trunk which locks the trucks and the body of the car together, thus adding the weight of the trucks to that of the car body. It is believed that this additional weight will help to keep the underframe from rising in case of a heavy buffing shock or collision.



Device for Locking Car Trucks to the Underframe.

Reference to the illustration will show the form and application of the lock. It consists of two steel keys, with flanges at the top and bottom, which pass through the body and truck bolsters. The king pin is inserted between the keys, spreading them out and the flanges prevent the body and truck bolsters from becoming separated. This arrangement has been made standard on both the Grand Trunk and Grand Trunk Pacific.

NEWS DEPARTMENT

Preliminary plans are being made for the electrification of the Chicago, Milwaukee & Puget Sound for a distance of 450 miles, from Harlowtown, Mont., to Avery, Idaho.

The Pennsylvania Railroad is to have first aid outfits carried in all baggage cars, so that each passenger train will carry two separate outfits, one in the baggage car and one on the locomotive.

The "Banner Limited," of the Wabash, running between Chicago and St. Louis, is now made up wholly of steel cars. This is the first of ten new solid steel trains to be put in service by the Wabash.

The New York, New Haven & Hartford has announced that the line between Stamford, Conn., and New Haven, 40 miles, will be ready for electric propulsion by July 1, next. With this extension trains can be hauled by electric locomotives from New Haven to New York, 74 miles.

The state of Texas has begun suit in court against the Gulf, Colorado & Santa Fe, and the Galveston, Harrisburg & San Antonio, to collect penalties aggregating $700,000 for running trains behind time, in violation of the law of that state under which a penalty is imposed if a passenger train is more than thirty minutes late.

The Pennsylvania Lines have issued a booklet for circulation among their employees, calling attention to the fact that the injuries to employees for the first nine months of 1912 show an increase over the same period of 1911, and exhorting everyone to increased care in order to prevent injuries. Special suggestions are made for employees in the different departments.

The first-aid-to-the-injured car of the American Red Cross Society is being run over the Lehigh Valley, stopping at all division and terminal points, and employees are invited to attend lectures and demonstrations by first-aid experts. Two physicians who were pioneers in this form of relief are in charge of the car. Men on other railroads and in nearby manufactories are invited.

The new governor of Indiana, Samuel M. Ralston, in his inaugural address calls for stricter regulation of the railroads and recommends the passage of a public utilities law. A bill has been introduced in the legislature providing for the abolition of the present state railroad commission and creating instead a public utilities commission, to have extensive powers like those exercised by the commissions of New York and certain other states.

At Sacramento, Cal., January 8, there was unveiled a bronze tablet, at Front and K streets, commemorating the fiftieth anniversary of the beginning of work on the Central Pacific. The monument stands on the spot where Governor Leland Stanford turned the first shovelful of earth. Dr. David Starr Jordan, president of Stanford University, delivered an address in the presence of a large number of veteran railroad men. Trains on the Southern Pacific everywhere were stopped for five minutes at the time of the unveiling.

SAFETY ON THE NEW YORK CENTRAL LINES

The months of September, October and November, 1912, as compared with June, July and August of the same year, showed considerable decreases in the number of employees injured in the shops of the New York Central lines. The decrease in injuries on the Cleveland, Cincinnati, Chicago & St. Louis ranged from 11.9 per cent. at the Mt. Carmel shops to 168.4 per cent. at the Bellefontaine shops. On the Lake Shore & Michigan Southern and subsidiary lines the percentage decreases ranged from 3.4 at the Kankakee shops to 87.7 at Root street, Chicago. During the six months, June to November, 1911, there were killed in all departments and branches 72 employees, and in the same months of 1912, 58 employees, a decrease of 19.4 per cent. It is claimed that credit for these decreases is largely due to the safety movement.

LOCOMOTIVES IN NEW YORK STATE

The annual report of the Public Service Commission for the Second district of New York shows that the number of locomotives owned by the railroads which operate wholly, or in part, in the state of New York, increased 4.6 per cent. in the five years from 1907 to 1912. The average tractive effort increased 17.1 per cent., and in 1912 was 30,200 lbs. In the same report an analysis is given of the causes of engine failures, and it is shown that hot bearings are responsible for 12.5 per cent., low steam for 15 per cent., steam leaks for 19.9 per cent., broken machinery for 19.5 per cent., miscellaneous, such as loose nuts, bolts, tires, wheels, burst air hose, etc., for 33.1 per cent. The New York Central & Hudson River had a locomotive mileage of 6,928 miles per engine failure during 1912. This includes all types of locomotives. The Delaware & Hudson had a mileage of 6,250 miles per engine failure. The report states that there have been no boiler explosions proper within the state in the five years during which the commission has supervised this work, notwithstanding the fact that there are over 6,000 locomotives constantly in use within the state and a large number additional in service a portion of the time. It is shown that the average age of boilers on the 9,201 locomotives recorded is 10.15 years.

FIREMEN'S WAGE DISPUTE

The committee representing the eastern railroads some days ago submitted to the representatives of the firemen a proposal that the questions of wages and other conditions now at issue between the companies and the men be settled mainly on the lines of the award recently made by the arbitration board in the matter of enginemen. The main feature of this offer is a minimum rate, but with modifications for locomotives weighing over 70 tons on the drivers. As in the case of the enginemen, the proposed schedule would increase the pay of firemen on many smaller roads, but not much on the larger systems. The principal rates are: passenger engines, $2.40 per 100 miles; over 70 tons and up to 87½ tons, 10 cents additional; 87½ tons and over, 15 cents additional, but with a maximum of $2.70 Through freight, $2.75; engines weighing over 70 tons, 10 cents additional, with a maximum of $3; engines weighing over 87½ tons, 15 cents additional with a maximum of $3.25; switching engines $2.45. Mr. Carter, president of the firemen, rejected the offer of the companies and suggested that no more time be lost in "useless conferences," but that matters be at once submitted to arbitration under the Erdman act. He said that the firemen would waive the clause in that act requiring a settlement in thirty days and would be willing to make the time limit sixty days. He submitted a tentative draft of an agreement to arbitrate. The roads replied that they wanted seven arbitrators, not three, which is the number provided for by the Erdman act. The efforts of Messrs. Knapp and Neill to find a ground for arbitration failed after a week of conference, and Mr. Carter announced that they would at once vote on empowering the officers of the brotherhood to order a strike. The result of the vote now being taken is not to be made known until February 10, but the railroads are confident that the vote will order a strike. They also concede that there should be adjustments in the pay of the firemen, but they desire arbitration by a

board sufficiently large to look at the controversy from all viewpoints, and appointed by some disinterested body.

MEETINGS AND CONVENTIONS

Railway Supply Manufacturers' Association.—The assignment of space for the exhibits which will be held in connection with the Master Mechanics' and Master Car Builders' conventions at Atlantic City next June, will take place on February 14.

New York Railroad Club.—The paper on the electro-pneumatic brake, by N. A. Camel, presented at the January meeting, is given in extract elsewhere in this issue. The discussion was confined exclusively to the use of the electro-pneumatic brake on passenger equipment, and it was shown that it has been in successful service on elevated and subway lines, and particularly on the New York, Westchester & Boston, where the braking requirements are unusually severe.

New England Railroad Club.—At the December meeting the subject of fire protection was brought up for discussion, being introduced by a paper from J. Albert Robinson, superintendent of fire records, National Fire Protection Association. The paper consisted largely of statistics on fire losses, both as to their cost in material and loss of life. The general causes of fires were briefly outlined and it was shown that carelessness caused the greatest number. Fire protection committees are doing excellent work in reducing fire hazards in some of the larger cities, and the methods employed and results obtained were mentioned by the author. The paper was discussed by a number of experts on fire protection, and the proceedings containing the account of the meeting forms an excellent treatise on the subject.

Central Railway Club.—The annual meeting was held in Buffalo on Thursday, January 9. Arthur Hale read a paper on Freight Car Tactics at the afternoon session. At the election which followed W. F. Jones, general storekeeper of the New York Central & Hudson River, was elected president; W. Elmer, Jr., superintendent motive power of the Pennsylvania, first vice-president; H. C. Manchester, superintendent motive power of the Delaware, Lackawanna & Western, second vice-president; E. J. Devans, superintendent of the Buffalo, Rochester & Pittsburgh, third vice-president; and Harry D. Vought, secretary. The annual banquet, held at the Hotel Statler during the evening, was largely attended. H. H. Vreeland, of New York, acted as toastmaster, and A. J. Grymes, manager marine department of the Erie; Arthur Hale and William McClellan, electrical engineer of the New York Public Service Commission, Second district, responded to toasts.

Canadian Railway Club.—L. C. Fritch, chief engineer of the Chicago Great Western, presented a paper on railway terminals at the January meeting. Impressive statistics were presented in connection with the cost of recent passenger terminals, showing that in several cases the fixed charges and maintenance of these terminals practically equaled the gross passenger earnings centering at these points. As an example, it was shown that the combined value of the passenger terminals in which the Pennsylvania Railroad is interested in the cities of Washington, Baltimore, Philadelphia and New York aggregate $178,000,000, or an average of nearly $800,000 per mile of road for the 223 miles from Washington to New York. The fixed charges alone on this investment average nearly $40,000 per mile on this part of the system. The subject of freight terminals was then considered in some detail, and the plan proposed by Jarvis Hunt for the terminals in Chicago was briefly explained. The subject of electrification of railway terminals was mentioned and, in the author's opinion, it is a matter that merits thorough investigation. Extracts from the address delivered by James J. Hill at the recent dinner of the Railway Business Association closed the paper.

Railway Club of Pittsburgh.—"Practical Methods of Abating Smoke," was the subject of the paper presented by J. M. Searle, chief of the division of smoke inspection of the city of Pittsburgh, at the November meeting. This paper drew attention to the enormous damage resulting from the smoky atmosphere and illustrated, by means of lantern slides, some of the methods and apparatus that are proving successful in eliminating it in connection with stationary boilers in the plants around Pittsburgh. The author complimented the railways on the work they have been doing in the reduction of smoke, and expressed a belief that the more extensive use of the locomotive stoker would continue to decrease the trouble. Conditions which the locomotive stoker must meet were outlined. The subject of smoke from roundhouses was mentioned as one of the greatest nuisances, but no suggestions were offered as to the best method of reducing it. In the discussion D. F. Crawford stated that the records of 21,000 trips of stoker locomotives show that on about 75 per cent. of the trips all of the coal was handled by the stoker, and on the remainder it ran from 99 per cent. to zero. The experience has been such as to lead the Pennsylvania to continue the application of the device. D. J. Redding explained the method by which the Pittsburgh and Lake Erie brought its passenger trains in the city without smoke.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 6-9, 1913, St. Louis, Mo.

AMERICAN RAILWAY MASTER MECHANICS' ASSOC.—J. W. Taylor, Old Colony building, Chicago. Convention, June 11-13, 1913, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—A. R. Davis, Central of Georgia, Macon, Ga.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa. Annual convention, June, 1913.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Annual meeting, December 3-6, Engineering Societies' Building, New York. Railroad session, Thursday morning, December 5.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, McCormick building, Chicago. Convention, May, 1913, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, Chicago & North Western, Escanaba, Mich.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—A. L. Woodworth, Lima, Ohio. Convention, August 18, 1913. Richmond, Va.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York. Convention, May 26-29, 1913, Chicago.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Old Colony building, Chicago. Convention, June 16-18, 1913, Atlantic City, N. J.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass. Convention, Sept 9-12, 1913, Ottawa, Can.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio. Convention, May 19-21, 1913, Auditorium Hotel, Chicago, Ill.

RAILROAD CLUB MEETINGS

Club.	Next Meeting.	Title of Paper.	Author.	Secretary.	Address.
Canadian	Feb. 11	Street Railway Construction	R. M. Hannaford	Jas. Powell	Room 13, Windsor Hotel, Montreal.
Central	Mar. 14	Rules of Interchange	Report of Committee.	H. D. Vought	95 Liberty St., New York.
New England	Feb. 11	Charcoal Iron Boiler Tubes	J. A. Kinkead	Wm. E. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Feb. 17	Safety First	J. W. Coon	H. D. Vought	95 Liberty St., New York.
Pittsburgh	Feb. 28	Locomotive Superheaters	G. E. Ryder	J. B. Anderson	Union Station, Pittsburgh, Pa.
Richmond	Feb. 10	Electric Shop Equipment	Chas. Fair and W. O. Kellogg	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Feb. 14	Railway Economics Simplified	W. W. Wheatley	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Feb. 18	Prevention of Railway Accidents	George Bradshaw	Jos. W. Taylor	390 Old Colony Bldg., Chicago.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

J. H. CARPENTER has been appointed chief motive power clerk of the Chesapeake & Ohio Railway of Indiana, with headquarters at Peru, Ind.

GEORGE O. HAMMOND has been appointed assistant to the mechanical superintendent of the New York, New Haven & Hartford, with headquarters at New Haven, Conn.

LLOYD B. JONES has been appointed assistant engineer of motive power of the Pennsylvania lines west of Pittsburgh, with office at Toledo, Ohio.

M. J. MCCARTHY, assistant superintendent of motive power of the Cleveland, Cincinnati, Chicago & St. Louis, has been appointed superintendent of motive power of the Baltimore & Ohio Southwestern and the Cincinnati, Hamilton & Dayton, with headquarters at Cincinnati, Ohio. Mr. McCarthy was born at Susquehanna, Pa., in 1868. He served an apprenticeship with the Erie Railroad at Susquehanna, leaving that road in 1889. Subsequently he worked in various railroad shops in the West and Southwest as a machinist and foreman. He was with the Chicago, Burlington & Quincy at Burlington, Ia., for ten years as machinist, inspector and general foreman; four years as division master mechanic of the Michigan Central at St. Thomas, Ont.; two years as division master mechanic of the Lake Shore & Michigan Southern at Elkhart, Ind.; three and one-half years as superintendent of shops of the Cleveland, Cincinnati, Chicago & St. Louis at Beech Grove, Ind., and assistant superintendent of motive power of the latter road at Indianapolis, Ind., for 18 months.

J. E. OSMER has been appointed superintendent of motive power and machinery, and master car builder of the Manistique & Lake Superior, with office at Owosso, Mich.

BENJAMIN T. PAYNE has been appointed general bonus supervisor of the Atchison, Topeka & Santa Fe, with office at Topeka, Kan., succeeding John Epler.

A. P. PRENDERGAST, superintendent of motive power of the Baltimore & Ohio at Cincinnati, Ohio, has been transferred to Baltimore, Md., with the same title.

J. H. TINKER, master mechanic of the Chicago & Eastern Illinois, at Danville, Ill., has been appointed acting superintendent of motive power, succeeding S. T. Park.

H. C. VAN BUSKIRK has resigned as superintendent of motive power and car department of the Colorado & Southern, owing to ill health.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

J. A. BARKER, road foreman of engines of the Chesapeake & Ohio Railway of Indiana, has been appointed trainmaster, with headquarters at Boston, Ind.

JOHN BENZIES has been appointed supervisor of locomotive operation of the Chicago terminal and Illinois divisions of the Rock Island Lines, with headquarters at Chicago, Ill., and will report to the master mechanic. He will have charge of the mechanical operation of all engines in service for the purpose of improving economies in the use of fuel, lubricating material, tools and other supplies, and in the operation of the locomotive. His efforts will also be directed toward reducing the cost of maintenance of locomotives and other operating costs, through improvements that may be brought about by better supervision and instruction of enginemen.

F. T. CHASE has been appointed master mechanic of the Smithville district of the Missouri, Kansas & Texas Railway of Texas, with headquarters at Smithville, Tex.

J. H. DOUGHERTY has been appointed acting master mechanic of the Waco district of the Missouri, Kansas & Texas Railway of Texas and the Texas Central, with headquarters at Waco, Texas.

GEORGE E. FULLER has been appointed road foreman of engines of the Chesapeake & Ohio Railway of Indiana, with headquarters at Peru, Ind.

D. HARTEL has been appointed assistant road foreman of engines of the Chicago division of the Baltimore & Ohio, succeeding George Novinger, promoted.

O. A. HOFFMAN has been appointed assistant to the road foreman of engines of the Chicago division of the Baltimore & Ohio, in charge of the instruction of firemen.

FRED. JUDY has been appointed road foreman of engines and air brake inspector of the Morgantown & Kinwood.

J. C. LOVE has been appointed road foreman of engines of the Los Angeles division of the Atchison, Topeka & Santa Fe, with headquarters at San Bernardino, Cal. The headquarters of A. L. Crew will be at Los Angeles and the territory of the division will be divided between the road foremen in accordance with the jurisdiction of the trainmasters.

J. P. MCANANY has been transferred as district master mechanic of the Canadian Pacific from Revelstoke, B. C., to Moose Jaw, Sask.

A. MALLINSON, general foreman of the Canadian Pacific at Revelstoke, B. C., has been appointed district master mechanic of the same road at Nelson, B. C.

GEORGE NOVINGER has been appointed road foreman of engines of the Chicago division of the Baltimore & Ohio.

D. PATTERSON, master mechanic of the Kansas City, Mexico & Orient at Wichita, Kan., will hereafter handle all matters pertaining to the motive power and car departments, and the office of superintendent of motive power and car departments heretofore held by F. Mertsheimer is abolished.

G. W. ROBB, master mechanic of the Grand Trunk Pacific, has transferred his office and staff from Rivers, Man., to Transcona, Man.

M. SCOTT has been transferred as district master mechanic of the Canadian Pacific from Nelson, B. C., to Revelstoke, B. C.

J. R. TIERNEY has been appointed road foreman of engines of the Parsons district of the Missouri, Kansas & Texas, vice C. I. Evans, promoted.

CAR DEPARTMENT

N. A. ALQUIST has been appointed general car inspector of the Missouri, Kansas & Texas, with office at Parsons, Kan.

SHOP AND ENGINE HOUSE

W. B. CHENOWETH has been appointed erecting shop foreman of the Trinity & Brazos Valley, at Teague, Tex., vice C. Murphy.

W. L. COOKE has been appointed erecting foreman of the Southern Pacific at Houston, Tex., succeeding W. T. Berger, assigned to other duties.

OSCAR C. DIBBLE has been appointed machine foreman of the Rock Island at Cedar Rapids, Ia., succeeding W. A. Yonda, resigned.

JOHN DUMPHY has been appointed foreman boiler maker of

the Rock Island at Argenta, Ark., succeeding J. H. Cotter, resigned.

J. C. Douval has been appointed apprentice instructor of the Southern Pacific at Houston, Tex.

W. R. Earl, machine shop foreman of the Baltimore & Ohio at Philadelphia, Pa., has been transferred in a similar capacity to Cumberland, Md.

G. W. Gilleland has been transferred as general foreman of the Seaboard Air Line from Monroe, N. C., to Hamlet, N. C.

Hugh Grant has been appointed assistant boiler foreman of the Southern Pacific at Houston, Tex.

A. H. Little has been appointed general foreman of the Seaboard Air Line at Raleigh, N. C.

A. McArthur, locomotive foreman of the Canadian Pacific at Sutherland, Sask., has been appointed general foreman of that road at Revelstoke, B. C.

E. J. McMahon, general foreman of the Southern Pacific, at Houston, Tex., has been appointed shop superintendent at Houston, vice M. J. McGraw, resigned, to go with the Chicago & Alton at Bloomington, Ill.

R. McPherson has been transferred as shop foreman of the Canadian Pacific from Brandon, Man., to Moose Jaw, Sask.

A. L. Monroe has been appointed general foreman of the Seaboard Air Line at Monroe, N. C.

C. Perry has been appointed shop foreman of the Canadian Pacific at Brandon, Man.

Harry S. Rauch has been made apprentice instructor at the Avis, Pa., shops of the New York Central & Hudson River. Mr. Rauch held a similar position at the Oswego, N. Y., shops of the same road until a couple of years ago, when he resigned to go into other business. He was awarded the first prize in the *Railway Age Gazette* Shop Section competition on the Instruction of Workmen and Apprentices in April, 1911.

W. Renix has been transferred as locomotive foreman of the Canadian Pacific from Moose Jaw, Sask., to Sutherland, Sask.

E. S. Sheppard has been appointed machine shop foreman of the Baltimore & Ohio at Philadelphia, Pa.

Wm. Urban, gang foreman, has been appointed general boiler foreman of the Atchison, Topeka & Santa Fe at Newton, Kans.

A. G. Walther has been appointed piece work inspector of the Baltimore & Ohio at the Mount Clare shops, Baltimore, Md.

PURCHASING AND STOREKEEPING

U. K. Hall has been appointed general storekeeper of the Oregon-Washington Railroad & Navigation Company, with headquarters at Portland, Oregon, succeeding J. E. Mahaney, resigned.

J. E. Mahaney, general storekeeper of the Oregon-Washington Railroad & Navigation Company, with office at Albian, Oregon, has been appointed purchasing agent of the Spokane, Portland & Seattle, the Oregon Trunk, the Oregon Electric and the United Railways, with headquarters at Portland, Oregon, to succeed F. A. Bushnell, resigned to accept service with another company.

J. R. Mueller has been appointed purchasing agent of the Hocking Valley, with office at Columbus, O., succeeding C. B. Duffy, deceased.

L. B. Wood has been appointed general storekeeper of the Sunset Central Lines of the Southern Pacific, with headquarters at Houston, Tex., succeeding R. L. Pries, who at his own request, on account of ill health, has been made storekeeper at Houston.

NEW SHOPS

Boston & Maine.—The work on the classification yard and engine terminal at Mechanicville, N. Y., has been started. The engine house, machine shop, coaling plant, etc., will be improved.

Canadian Pacific.—It is reported that this company will move the headquarters of the Dominion Atlantic division, together with the car shops, from Kentville, N. S., to Middleton.

Central New England.—The improvements at Maybrook, N. Y., consisting of an engine house, power house, machine shop and coaling plant, are about completed, and the engine house is in operation.

Chicago & North Western.—This company has purchased 260 acres between Kenosha, Wis., and Racine, for yards, engine houses and shops.

Detroit, Bay City & Western.—The engine house at Bay City, Mich., was destroyed by fire January 8. It is estimated the loss will amount to $20,000.

Grand Trunk Pacific.—It has been reported that during the present year new shops will be erected at Edmonton, Alberta. The expense will be defrayed from a $2,000,000 appropriation.

Gulf, Colorado & Santa Fe.—Work on the 8-stall engine house at San Angelo, Tex., will be started in the near future,

Houston & Texas Central.—It is reported that the machine shops at Hearne, Tex., will be enlarged to about double their capacity. There will be additions made to the yard as well.

International & Great Northern.—Plans are being prepared for an engine house and machine shop at San Antonio, Tex., which will cost approximately $35,000.

Louisville & Nashville.—It is reported that this company will spend about $200,000 in enlarging its shops at Howell, Ind.

Missouri, Kansas & Texas.—The shops at Denison, Tex., will be enlarged.

Missouri, Oklahoma & Gulf.—The engine house and shops at Muskogee, Okla., were recently burned, causing a loss of about $40,000. They will be rebuilt on a larger scale.

Northern Pacific.—This road will build a large addition to its car shops at Tacoma, Wash. It is reported that a new engine house will be built at Toppenish, Wash.

Pennsylvania.—The work on the addition to the engine house at Morrisville, Pa., has begun. Nine new stalls, a blacksmith shop, and a new machine shop will be built. The old machine shop is to be converted into a power house.

Pittsburgh & Lake Erie.—New shops will be built by the company at Dickerson Run, Pa. The power house will be 60 ft. x 70 ft., the engine house 100 ft. x 60 ft., and the machine shops 60 ft. x 130 ft. The plans are now being made by the road, and it is expected that the details will be ready in the spring.

St. Louis, Brownsville & Mexico.—A coach repair shop will be installed at Kingsville, Tex.

San Antonio & Aransas Pass.—This company is erecting three additional buildings at its shops at Yoakum, Tex., 50 x 150 ft., 28 x 100 ft., and 50 x 80 ft.

Scott City Northern.—A two-stall engine house, store house, and a blacksmith shop has been built at Scott City, Kan. This work was started last September.

Southern Pacific.—The plans for the re-location of the repair shops at Sacramento, Cal., are nearly finished. Improvements will cost approximately $100,000.

SUPPLY TRADE NOTES

J. B. Rider, general manager of the Pressed Steel Car Co., has been elected a director of that company.

The Carbon Steel Company, New York, has moved its offices from 30 Church street to the Cameron building.

G. E. Fuller, Aroa, Puerto Cabello, Venezuela, would like to receive catalogs of railway machine tools, locomotives, cars and appliances.

Harry Lowman, formerly in the mechanical department of the Southern Railway at Washington, D. C., has entered the sales department of the Chicago Car Heating Co., Chicago.

J. L. Stark, general inspector of the car department of the Hocking Valley, at Columbus, Ohio, has resigned to become a representative of the Chicago-Cleveland Car Roofing Company, with office at Chicago.

Gilbert H. Pearsall, secretary of Joseph T. Ryerson & Son, in charge of railroad sales, with headquarters in New York, has resigned to engage in business for himself. Edward T. Hendee, assistant to the president, has assumed the duties formerly devolving on Mr. Pearsall.

J. E. Chisholm has been made a representative of the Universal Flexible Packing Company, Pittsburgh, Pa., with offices in the Old Colony building, Chicago; and George R. Argo has been made representative of the same company, with office in the Third National Bank building, Atlanta, Ga.

Fred Gardner, for several years railroad representative for J. T. Ryerson & Son, Chicago, resigned on January 1, and is now representing the Jacobs-Shupert Firebox Company, Oxweld Railroad Service Company, Burden Iron Company, Boss Nut Company, and other railroad specialties, with office at 339 Railway Exchange building, Chicago.

The General Pipe, Bending & Erecting Company, with headquarters at 3020 Liberty street, Pittsburgh, Pa., has been incorporated under the laws of the state of Pennsylvania. The incorporators are James W. Prenter, W. L. James and Walter C. McMinn, all of whom were formerly connected with the Best Manufacturing Company. The new company will manufacture and fabricate piping materials of every description.

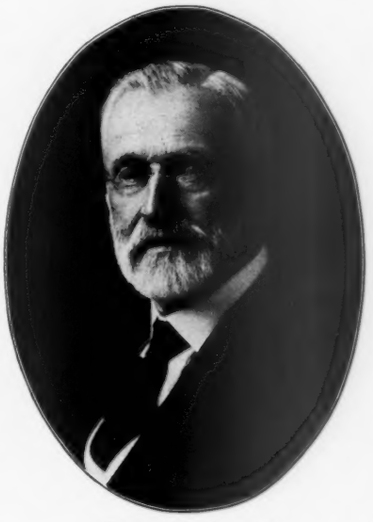
William B. Hall has resigned as vice-president and general manager of the Illinois Car & Manufacturing Company, to promote the interests of the Union Railway Equipment Company, of Chicago, which has taken over the patented devices invented by Herman Pries, superintendent of the Haskell & Barker Car Company. Mr. Hall was formerly superintendent of equipment of the Mather Horse & Stock Car Company.

The annual convention of the sales and factory organizations of the Chicago Pneumatic Tool Company, was held at the show rooms of the company, 1337 South Michigan avenue, Chicago, on January 9, 10 and 11, concluding with a banquet on Saturday evening, January 11, at the Chicago Automobile Club. Nearly 100 of the company's representatives were present. The meeting was opened on Thursday morning with an address by President W. O. Duntley, and the succeeding meetings were divided into sessions devoted respectively to the air compressor department, railroad department, Cleveland plant, general sales department, Detroit plant, electrical department and commercial automobile department.

The Burden Sales Company, with general offices at 30 Church street, New York, and sales offices in Chicago, Atlanta and St. Paul, has been organized by Gilbert H. Pearsall, president; H. H. Linton, vice-president, and Craig Graves, secretary and treasurer, to be a distributor of the products of the Burden Iron Company of Troy, N. Y., makers of staybolt iron, "Burden Best" high grade refined iron for car work, engine bolt iron and Burden iron rivets. In connection with the general offices of the Burden Sales Company will be the eastern sales office of the Jacobs-Shupert United States Firebox Company and the Oxweld Railroad Service Company. Notice of Mr. Pearsall's election to the vice-presidency of these companies appeared in the August and September, 1912, issues of the *American Engineer*.

The Standard Heat & Ventilation Company, Inc., 141 Cedar street, New York, has recently been incorporated and has bought the rights of the Ward Equipment Company, New York, and the Safety Car Heating & Lighting Company, New York, relating to car heating and ventilating, and will make and sell the devices in these special lines hitherto furnished by the two latter companies. The Safety Car Heating & Lighting Company will also act as its agent. The company has now at its disposal a new plant especially equipped for the manufacture of railway car heating and ventilating appliances. The directors of the company are as follows: C. B. Adams, Wm. Barbour, R. M. Dixon, A. W. Kiddle, W. B. Albright, J. F. Deems, W. L. Garland, A. C. Moore and John E. Ward. The officers of the company are as follows: President, J. F. Deems; vice-presidents, A. W. Kiddle and A. L. Whipple; treasurer, A. C. Moore, and secretary and assistant treasurer, John J. Clapp.

George Myrick Sargent, of Evanston, Ill., the founder of the first plant in the United States for the exclusive manufacture of brake shoes, and at the time of his death a director of the American Brake Shoe & Foundry Company, died at Atlantic City, N. J., on January 16, at the age of 83. Mr. Sargent patented in 1878 an improvement in brake shoe manufacture which led to the development of the American Brake Shoe & Foundry Company. He was born in Sedgwick, Maine, March 29, 1830, and after being engaged for several years in various lines of business in the east entered the iron industry at Moline, Ill., in 1870 as part owner of the Moline Malleable Iron Works. In 1876 he removed to Chicago and invented and designed an improved brake shoe, subsequently known as the Congdon, and organized a company for its production under the name of George M. Sargent & Co. In 1878 it was incorporated as a stock company under the name of the Congdon Brake Shoe Company, and in 1893 a new corporation was organized to carry on the business under the name of the Sargent Company, with Mr. Sargent as president. The company operated two plants, one for the exclusive manufacture of cast iron brake shoes, and another, which after 1896, was devoted almost entirely to the production of couplers, knuckles and steel brake shoes. This business was successfully carried on until 1901, when the American Brake Shoe & Foundry Company, promoted by W. D. Sargent and others, was organized and when it purchased the Chicago Heights plant. Shortly afterward the original plant of the company at Fifty-ninth street, was acquired by the American Steel Foundries. Mr. Sargent was a director of the American Brake Shoe & Foundry Company, and was a past president of the Live Poultry Transportation Company. In 1901 he was elected vice-president for Illinois of the National Association of Manufacturers.



George M. Sargent.

CATALOGS

Cold Metal Saws.—The Vulcan Engineering Sales Company, Fisher Building, Chicago, has issued a catalog illustrating various types of cold metal saws. It also deals with rotary planers and power driven hack saws.

Heading Machines.—The National Machinery Co., Tiffin, Ohio, has issued a three page pamphlet describing the die box construction of the National wedge grip header. This is number six in a series of talks on this machine.

Power Hammers.—Beaudry & Company, Incorporated, Boston, Mass., have issued a six-page pamphlet illustrating and describing their belt-driven hammers. These are made in two types, one being intended for heavy forging and the other for plating, drawing, etc.

Air Compressors.—Bulletin No. 34-F from the Chicago Pneumatic Tool Company, Chicago, Ill., comprises 26 pages devoted exclusively to a mechanical description of the design and construction of the Class G Chicago air compressors. This description applies to belt, steam and motor driven compressors, and is fully illustrated, both with photographic reproductions of various parts and sectional drawings showing the interior arrangement.

Electric Forge Blowers.—Forge blowers direct connected to either alternating or direct current motors and providing any desired quantity of air up to 400 cu. ft. per minute and at pressures up to 2 oz., form the subject of bulletin 3313 from the Emerson Electric Manufacturing Company, St. Louis, Mo. The bulletin gives a very full description of these machines and includes tables of capacities, dimensions, weights, etc., for each type and size.

Metal Paint.—A 12-page pamphlet has been issued by the Formastat Mining Company, St. Louis, Mo., describing their paint pigment particularly adapted to the preservation of iron, steel, metals, woodwork, or any artificial surface exposed to the elements and influence of destructive gases. The pigment Formastat is described and its various characteristics mentioned. Various formulas are contained in the pamphlet for its different uses.

Current'o Scope.—Fairbanks, Morse & Company, Chicago, Ill., have distributed a device made of celluloid, which shows by means of the standard vector diagram, the relation of the instantaneous values of an alternating current in a three-phase circuit. By a simple mechanical arrangement this shows how these currents combine in the windings of a three-phase motor to produce the phenomenon of the revolving field. The device is very ingenious, and illustrates very clearly just the manner in which these currents act. Instructions for use accompany the Current'o Scope.

Gate Valves.—A small catalog devoted exclusively to gate valves made with either brass or iron bodies for steam pressures from 125 lbs. to 250 lbs., or for water pressures from 175 lbs. to 400 lbs. per sq. in., is being issued by Jenkins Bros., 80 White street, New York. These valves are of the solid wedge, double faced type and have an improved body and bonnet, designed to secure an increased strength and rigidity, and enabling the valve to resist the severe stresses of poorly supported piping, temperature changes, etc., without distortion. The stuffing boxes can be repacked when the valves are open and under pressure. Many sizes and designs are illustrated in the catalog and each is accompanied by a complete price list.

Pipe Machines.—The Bignall and Keeler Manufacturing Company, Edwardsville, Ill., has had thirty years' experience in the designing and building of improved pipe machines, and is among the best known specialists in this line. The three styles that it manufactures, which differ from each other principally in the design of the chuck, are all of the stationary die type. The die head is bolted to a carriage which slides forward toward the chuck as the thread is cut. These are very fully illustrated and described in a recent catalog issued by this company. Each of the three styles is built in several sizes, and each size has a capacity of from eight to ten sizes of pipe. Machines are generally shown as belt driven, although an example with a motor drive is included. Several of those shown are provided with a gear box which gives eight changes of spindle speed.

Electric Appliances.—Among the recent bulletins from the General Electric Company, Schenectady, New York, is one on electric hardening furnaces which supersedes the previous bulletin on this subject. It gives a full description of the construction and the method of operation of the electric furnace for hardening tool steel. Another bulletin from the same company describes and illustrates portable and stationary air compressor sets having a piston displacement of from 15 cu. ft. to 100 cu. ft. per minute. These are motor driven and are automatic in their operation. Polyphase induction motors is the subject of bulletin A-4063, which supersedes a former publication on this subject. This type of motor is being widely used and has many advantages where the ability to carry large overloads for considerable periods and without serious overheating is desired. The bulletin thoroughly covers the subject and is fully illustrated. Electric fans in practically all sizes and arrangements are shown in bulletin A-4065 from the same company, and Mazda lamps for standard lighting service are illustrated in bulletin 4850-C.

Transporting Perishable Products.—The Moore system, which combines refrigeration, heating and ventilation of cars intended for transporting perishable products, is illustrated and fully described in a catalog issued by the Moore Patent Car Company, St. Paul, Minn. With this system it is not necessary to break the seal or enter the car to change to or from refrigeration, heat or ventilation. The arrangement provides ice tanks just below the ceiling in the center of the car and a heater box enclosing a coal stove is under the floor and has an outside door. The heater is entirely automatic in its operation and draws fresh air from the outside which, after being heated, is discharged to the interior of the car. For ventilation there are six openings in the roof at the center of the car, three on either side so arranged that the covers on one side open toward one end of the car while those on the other open in the opposite direction. In this manner air is forced in at one side and discharged from the other and a positive circulation in the car is insured independent of the direction in which it is moving. The illustrations make the construction and operation clear.

Acetylene Welding and Cutting Apparatus.—Catalog Q of the Alexander Milburn Company, Baltimore, Md., consists of 32 pages principally devoted to illustrations and description of the oxy-acetylene welding and cutting apparatus manufactured by this company. This includes an acetylene generator, in which the feed is rotary, and of the indirect carbide-into-water type which makes it impossible to get an excessive charge of carbide or to feed in any way except through the normal working of the generator. The apparatus and operation are simple and the generator is readily adapted to any pressure desired from 2 lbs. to 15 lbs. Oxygen is provided in cylinders which are usually loaned and refilled or exchanged at various depots throughout the United States and Canada. Portable sets, both those having an acetylene generator and the other apparatus mounted on a truck, and those where both the oxygen and acetylene are stored in tanks are illustrated. For use in places where oxygen supply stations are not convenient an oxygen generator is furnished, and is fully illustrated and described in the catalog. Torches, regulator valves, gages and other welding supplies are also shown.